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(54) Title: CORYNEBACTERIUM GLUTAMICUM GENES ENCODING STRESS, RESISTANCE AND TOLERANCE PROTEINS

(57) Abstract: Isolated nucleic acid molecules, designated SRT nucleic acid molecules, which encode novel SRT proteins from *Corynebacterium glutamicum* are described. The invention also provides antisense nucleic acid molecules, recombinant expression vectors containing SRT nucleic acid molecules, and host cells into which the expression vectors have been introduced. The invention still further provides isolated SRT proteins, mutated SRT proteins, fusion proteins, antigenic peptides and methods for the improvement of production of a desired compound from *C. glutamicum* based on genetic engineering of SRT genes in this organism.

**CORYNEBACTERIUM GLUTAMICUM GENES ENCODING STRESS,  
RESISTANCE AND TOLERANCE PROTEINS**

**Related Applications**

5           This application claims priority to prior filed U.S. Provisional Patent Application Serial No. 60/141031, filed June 25, 1999, U.S. Provisional Patent Application Serial No. 60/142692, filed July 1, 1999, and also to U.S. Provisional Patent Application Serial No. 60/151214, filed August 27, 1999. This application also claims priority to German Patent Application No. 19930429.7, filed July 1, 1999, German Patent Application No. 10   19931413.6, filed July 8, 1999, German Patent Application No. 19931457.8, filed July 8, 1999, German Patent Application No. 19931541.8, filed July 8, 1999, German Patent Application No. 19932209.0, filed July 9, 1999, German Patent Application No. 19932230.9, filed July 9, 1999, German Patent Application No. 19932914.1, filed July 14, 1999, German Patent Application No. 19940764.9, filed August 27, 1999, and 15   German Patent Application No. 19941382.7, filed August 31, 1999. The entire contents of all of the aforementioned applications are hereby expressly incorporated herein in their entirety by this reference.

**Background of the Invention**

20           Certain products and by-products of naturally-occurring metabolic processes in cells have utility in a wide array of industries, including the food, feed, cosmetics, and pharmaceutical industries. These molecules, collectively termed 'fine chemicals', include organic acids, both proteinogenic and non-proteinogenic amino acids, nucleotides and nucleosides, lipids and fatty acids, diols, carbohydrates, aromatic 25   compounds, vitamins and cofactors, and enzymes. Their production is most conveniently performed through large-scale culture of bacteria developed to produce and secrete large quantities of a particular desired molecule. One particularly useful organism for this purpose is *Corynebacterium glutamicum*, a gram positive, nonpathogenic bacterium. Through strain selection, a number of mutant strains have 30   been developed which produce an array of desirable compounds. However, selection of strains improved for the production of a particular molecule is a time-consuming and difficult process.



### Summary of the Invention

The invention provides novel bacterial nucleic acid molecules which have a variety of uses. These uses include the identification of microorganisms which can be used to produce fine chemicals, the modulation of fine chemical production in *C. glutamicum* or related bacteria, the typing or identification of *C. glutamicum* or related bacteria, as reference points for mapping the *C. glutamicum* genome, and as markers for transformation. These novel nucleic acid molecules encode proteins, referred to herein as stress, resistance and tolerance (SRT) proteins.

*C. glutamicum* is a gram positive, aerobic bacterium which is commonly used in industry for the large-scale production of a variety of fine chemicals, and also for the degradation of hydrocarbons (such as in petroleum spills) and for the oxidation of terpenoids. The SRT nucleic acid molecules of the invention, therefore, can be used to identify microorganisms which can be used to produce fine chemicals, e.g., by fermentation processes. Modulation of the expression of the SRT nucleic acids of the invention, or modification of the sequence of the SRT nucleic acid molecules of the invention, can be used to modulate the production of one or more fine chemicals from a microorganism (e.g., to improve the yield or production of one or more fine chemicals from a *Corynebacterium* or *Brevibacterium* species).

The SRT nucleic acids of the invention may also be used to identify an organism as being *Corynebacterium glutamicum* or a close relative thereof, or to identify the presence of *C. glutamicum* or a relative thereof in a mixed population of microorganisms. The invention provides the nucleic acid sequences of a number of *C. glutamicum* genes; by probing the extracted genomic DNA of a culture of a unique or mixed population of microorganisms under stringent conditions with a probe spanning a region of a *C. glutamicum* gene which is unique to this organism, one can ascertain whether this organism is present. Although *Corynebacterium glutamicum* itself is nonpathogenic, it is related to species pathogenic in humans, such as *Corynebacterium diphtheriae* (the causative agent of diphtheria); the detection of such organisms is of significant clinical relevance.

The SRT nucleic acid molecules of the invention may also serve as reference points for mapping of the *C. glutamicum* genome, or of genomes of related organisms.

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Similarly, these molecules, or variants or portions thereof, may serve as markers for genetically engineered *Corynebacterium* or *Brevibacterium* species.

The SRT proteins encoded by the novel nucleic acid molecules of the invention are capable of, for example, permitting *C. glutamicum* to survive in a setting which is  
5 either chemically or environmentally hazardous to this microorganism. Given the availability of cloning vectors for use in *Corynebacterium glutamicum*, such as those disclosed in Sinskey *et al.*, U.S. Patent No. 4,649,119, and techniques for genetic manipulation of *C. glutamicum* and the related *Brevibacterium* species (*e.g.*, *lactofermentum*) (Yoshihama *et al.*, *J. Bacteriol.* 162: 591-597 (1985); Katsumata *et al.*,  
10 *J. Bacteriol.* 159: 306-311 (1984); and Santamaria *et al.*, *J. Gen. Microbiol.* 130: 2237-2246 (1984)), the nucleic acid molecules of the invention may be utilized in the genetic engineering of this organism to make it a better or more efficient producer of one or more fine chemicals, through the ability of these proteins to permit growth and multiplication of *C. glutamicum* (and also continuous production of one or more fine  
15 chemicals) under circumstances which would normally impede growth of the organism, such as those conditions frequently encountered during large-scale fermentative growth. For example, by overexpressing or engineering a heat-shock induced protease molecule such that it is optimized in activity, one may increase the ability of the bacterium to degrade incorrectly folded proteins when the bacterium is challenged with high  
20 temperatures. By having fewer misfolded (and possibly misregulated or nonfunctional) proteins to interfere with normal reaction mechanisms in the cell, the cell is increased in its ability to function normally in such a culture, which should in turn provide increased viability. This overall increase in number of cells having greater viability and activity in the culture should also result in an increase in yield, production, and/or efficiency of  
25 production of one or more desired fine chemicals, due at least to the relatively greater number of cells producing these chemicals in the culture.

This invention provides novel SRT nucleic acid molecules which encode SRT proteins which are capable of, for example, permitting *C. glutamicum* to survive in a setting which is either chemically or environmentally hazardous to this microorganism.  
30 Nucleic acid molecules encoding an SRT protein are referred to herein as SRT nucleic acid molecules. In a preferred embodiment, the SRT protein participates in metabolic pathways permitting *C. glutamicum* to survive in a setting which is either chemically or

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environmentally hazardous to this microorganism. Examples of such proteins include those encoded by the genes set forth in Table 1.

Accordingly, one aspect of the invention pertains to isolated nucleic acid molecules (*e.g.*, cDNAs, DNAs, or RNAs) comprising a nucleotide sequence encoding an SRT protein or biologically active portions thereof, as well as nucleic acid fragments suitable as primers or hybridization probes for the detection or amplification of SRT-encoding nucleic acid (*e.g.*, DNA or mRNA). In particularly preferred embodiments, the isolated nucleic acid molecule comprises one of the nucleotide sequences set forth as the odd-numbered SEQ ID NOs in the Sequence Listing (*e.g.*, SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7....), or the coding region or a complement thereof of one of these nucleotide sequences. In other particularly preferred embodiments, the isolated nucleic acid molecule of the invention comprises a nucleotide sequence which hybridizes to or is at least about 50%, preferably at least about 60%, more preferably at least about 70%, 80% or 90%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to a nucleotide sequence set forth as an odd-numbered SEQ ID NO in the Sequence Listing (*e.g.*, SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7....), or a portion thereof. In other preferred embodiments, the isolated nucleic acid molecule encodes one of the amino acid sequences set forth as an even-numbered SEQ ID NO in the Sequence Listing (*e.g.*, SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8....). The preferred SRT proteins of the present invention also preferably possess at least one of the SRT activities described herein.

In another embodiment, the isolated nucleic acid molecule encodes a protein or portion thereof wherein the protein or portion thereof includes an amino acid sequence which is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence having an even-numbered SEQ ID NO: in the Sequence Listing), *e.g.*, sufficiently homologous to an amino acid sequence of the invention such that the protein or portion thereof maintains an SRT activity. Preferably, the protein or portion thereof encoded by the nucleic acid molecule maintains the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism. In one embodiment, the protein encoded by the nucleic acid molecule is at least about 50%, preferably at least about 60%, and more preferably at least about 70%, 80%, or 90% and most preferably at least about 95%, 96%, 97%, 98%, or 99% or

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more homologous to an amino acid sequence of the invention (*e.g.*, an entire amino acid sequence selected from those having an even-numbered SEQ ID NO in the Sequence Listing). In another preferred embodiment, the protein is a full length *C. glutamicum* protein which is substantially homologous to an entire amino acid sequence of the invention (encoded by an open reading frame shown the corresponding odd-numbered SEQ ID NOs in the Sequence Listing (*e.g.*, SEQ ID NO:1, SEQ ID NO:3, SEQ ID NO:5, SEQ ID NO:7....)).

In another preferred embodiment, the isolated nucleic acid molecule is derived from *C. glutamicum* and encodes a protein (*e.g.*, an SRT fusion protein) which includes a biologically active domain which is at least about 50% or more homologous to one of the amino acid sequences of the invention (*e.g.*, a sequence of one of the even-numbered SEQ ID NOs in the Sequence Listing) and has the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism, or possesses one or more of the activities set forth in Table 1, and which also includes heterologous nucleic acid sequences encoding a heterologous polypeptide or regulatory regions.

In another embodiment, the isolated nucleic acid molecule is at least 15 nucleotides in length and hybridizes under stringent conditions to a nucleic acid molecule comprising a nucleotide sequence of the invention (*e.g.*, a sequence of an odd-numbered SEQ ID NO in the Sequence Listing). Preferably, the isolated nucleic acid molecule corresponds to a naturally-occurring nucleic acid molecule. More preferably, the isolated nucleic acid encodes a naturally-occurring *C. glutamicum* SRT protein, or a biologically active portion thereof.

Another aspect of the invention pertains to vectors, *e.g.*, recombinant expression vectors, containing the nucleic acid molecules of the invention, and host cells into which such vectors have been introduced. In one embodiment, such a host cell is used to produce an SRT protein by culturing the host cell in a suitable medium. The SRT protein can be then isolated from the medium or the host cell.

Yet another aspect of the invention pertains to a genetically altered microorganism in which an SRT gene has been introduced or altered. In one embodiment, the genome of the microorganism has been altered by the introduction of a nucleic acid molecule of the invention encoding wild-type or mutated SRT sequence as



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a transgene. In another embodiment, an endogenous SRT gene within the genome of the microorganism has been altered, *e.g.*, functionally disrupted, by homologous recombination with an altered SRT gene. In another embodiment, an endogenous or introduced SRT gene in a microorganism has been altered by one or more point mutations, deletions, or inversions, but still encodes a functional SRT protein. In still another embodiment, one or more of the regulatory regions (*e.g.*, a promoter, repressor, or inducer) of a SRT gene in a microorganism has been altered (*e.g.*, by deletion, truncation, inversion, or point mutation) such that the expression of the SRT gene is modulated. In a preferred embodiment, the microorganism belongs to the genus *Corynebacterium* or *Brevibacterium*, with *Corynebacterium glutamicum* being particularly preferred. In a preferred embodiment, the microorganism is also utilized for the production of a desired compound, such as an amino acid, with lysine being particularly preferred.

In another aspect, the invention provides a method of identifying the presence or activity of *Corynebacterium diphtheriae* in a subject. This method includes detection of one or more of the nucleic acid or amino acid sequences of the invention (*e.g.*, the sequences set forth in the Sequence Listing as SEQ ID NOs 1 through 304)) in a subject, thereby detecting the presence or activity of *Corynebacterium diphtheriae* in the subject.

Still another aspect of the invention pertains to an isolated SRT protein or a portion, *e.g.*, a biologically active portion, thereof. In a preferred embodiment, the isolated SRT protein or portion thereof possesses the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism. In another preferred embodiment, the isolated SRT protein or portion thereof is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: in the Sequence Listing) such that the protein or portion thereof maintains the ability to increase the survival of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism.

The invention also provides an isolated preparation of an SRT protein. In preferred embodiments, the SRT protein comprises an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing). In another preferred embodiment, the invention pertains to an isolated full length protein

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which is substantially homologous to an entire amino acid sequence of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) (encoded by an open reading frame set forth in a corresponding odd-numbered SEQ ID NO: of the Sequence Listing).). In yet another embodiment, the protein is at least about 50%,  
5 preferably at least about 60%, and more preferably at least about 70%, 80%, or 90%, and most preferably at least about 95%, 96%, 97%, 98%, or 99% or more homologous to an entire amino acid sequence of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing). In other embodiments, the isolated SRT protein comprises an amino acid sequence which is at least about 50% or more homologous to  
10 one of the amino acid sequences of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) and is able to improve the survival rate of *C. glutamicum* in a setting which is either chemically or environmentally hazardous to this microorganism, or has one or more of the activities set forth in Table 1.

Alternatively, the isolated SRT protein can comprise an amino acid sequence  
15 which is encoded by a nucleotide sequence which hybridizes, e.g., hybridizes under stringent conditions, or is at least about 50%, preferably at least about 60%, more preferably at least about 70%, 80%, or 90%, and even more preferably at least about 95%, 96%, 97%, 98,%, or 99% or more homologousto a nucleotide sequence of one of the even-numbered SEQ ID NOs set forth in the Sequence Listing. It is also preferred  
20 that the preferred forms of SRT proteins also have one or more of the SRT bioactivities described herein.

The SRT polypeptide, or a biologically active portion thereof, can be operatively linked to a non-SRT polypeptide to form a fusion protein. In preferred embodiments, this fusion protein has an activity which differs from that of the SRT protein alone. In  
25 other preferred embodiments, this fusion protein results in increased yields, production, and/or efficiency of production of a desired fine chemical from *C. glutamicum*. In particularly preferred embodiments, integration of this fusion protein into a host cell modulates the production of a desired compound from the cell.

In another aspect, the invention provides methods for screening molecules which  
30 modulate the activity of an SRT protein, either by interacting with the protein itself or a substrate or binding partner of the SRT protein, or by modulating the transcription or translation of an SRT nucleic acid molecule of the invention.

Another aspect of the invention pertains to a method for producing a fine chemical. This method involves the culturing of a cell containing a vector directing the expression of an SRT nucleic acid molecule of the invention, such that a fine chemical is produced. In a preferred embodiment, this method further includes the step of obtaining  
5 a cell containing such a vector, in which a cell is transfected with a vector directing the expression of an SRT nucleic acid. In another preferred embodiment, this method further includes the step of recovering the fine chemical from the culture. In a particularly preferred embodiment, the cell is from the genus *Corynebacterium* or *Brevibacterium*, or is selected from those strains set forth in Table 3.

10 Another aspect of the invention pertains to methods for modulating production of a molecule from a microorganism. Such methods include contacting the cell with an agent which modulates SRT protein activity or SRT nucleic acid expression such that a cell associated activity is altered relative to this same activity in the absence of the agent. In a preferred embodiment, the cell is modulated in resistance to one or more  
15 toxic chemicals or in resistance to one or more environmental stresses, such that the yields or rate of production of a desired fine chemical by this microorganism is improved. The agent which modulates SRT protein activity can be an agent which stimulates SRT protein activity or SRT nucleic acid expression. Examples of agents which stimulate SRT protein activity or SRT nucleic acid expression include small  
20 molecules, active SRT proteins, and nucleic acids encoding SRT proteins that have been introduced into the cell. Examples of agents which inhibit SRT activity or expression include small molecules, and antisense SRT nucleic acid molecules.

Another aspect of the invention pertains to methods for modulating yields of a desired compound from a cell, involving the introduction of a wild-type or mutant SRT  
25 gene into a cell, either maintained on a separate plasmid or integrated into the genome of the host cell. If integrated into the genome, such integration can random, or it can take place by homologous recombination such that the native gene is replaced by the introduced copy, causing the production of the desired compound from the cell to be modulated. In a preferred embodiment, said yields are increased. In another preferred  
30 embodiment, said chemical is a fine chemical. In a particularly preferred embodiment, said fine chemical is an amino acid. In especially preferred embodiments, said amino acid is L-lysine.

### Detailed Description of the Invention

The present invention provides SRT nucleic acid and protein molecules which are involved in the survival of *C. glutamicum* upon exposure of this microorganism to chemical or environmental hazards. The molecules of the invention may be utilized in the modulation of production of fine chemicals from microorganisms, since these SRT proteins provide a means for continued growth and multiplication of *C. glutamicum* in the presence of toxic chemicals or hazardous environmental conditions, such as may be encountered during large-scale fermentative growth. By increasing the growth rate or at least maintaining normal growth in the face of poor, if not toxic, conditions, one may increase the yield, production, and/or efficiency of production of one or more fine chemicals from such a culture, at least due to the relatively greater number of cells producing the fine chemical in the culture. Aspects of the invention are further explicated below.

#### 15 I. Fine Chemicals

The term 'fine chemical' is art-recognized and includes molecules produced by an organism which have applications in various industries, such as, but not limited to, the pharmaceutical, agriculture, and cosmetics industries. Such compounds include organic acids, such as tartaric acid, itaconic acid, and diaminopimelic acid, both proteinogenic and non-proteinogenic amino acids, purine and pyrimidine bases, nucleosides, and nucleotides (as described *e.g.* in Kuninaka, A. (1996) Nucleotides and related compounds, p. 561-612, in Biotechnology vol. 6, Rehm *et al.*, eds. VCH: Weinheim, and references contained therein), lipids, both saturated and unsaturated fatty acids (*e.g.*, arachidonic acid), diols (*e.g.*, propane diol, and butane diol), carbohydrates (*e.g.*, hyaluronic acid and trehalose), aromatic compounds (*e.g.*, aromatic amines, vanillin, and indigo), vitamins and cofactors (as described in Ullmann's Encyclopedia of Industrial Chemistry, vol. A27, "Vitamins", p. 443-613 (1996) VCH: Weinheim and references therein; and Ong, A.S., Niki, E. & Packer, L. (1995) "Nutrition, Lipids, Health, and Disease" Proceedings of the UNESCO/Confederation of Scientific and Technological Associations in Malaysia, and the Society for Free Radical Research – Asia, held Sept. 1-3, 1994 at Penang, Malaysia, AOCS Press, (1995)), enzymes, polyketides (Cane *et al.* (1998) *Science* 282: 63-68), and all other chemicals described in



Gutcho (1983) Chemicals by Fermentation, Noyes Data Corporation, ISBN: 0818805086 and references therein. The metabolism and uses of certain of these fine chemicals are further explicated below.

5    A. *Amino Acid Metabolism and Uses*

Amino acids comprise the basic structural units of all proteins, and as such are essential for normal cellular functioning in all organisms. The term "amino acid" is art-recognized. The proteinogenic amino acids, of which there are 20 species, serve as structural units for proteins, in which they are linked by peptide bonds, while the  
10   nonproteinogenic amino acids (hundreds of which are known) are not normally found in proteins (see Ulmann's Encyclopedia of Industrial Chemistry, vol. A2, p. 57-97 VCH: Weinheim (1985)). Amino acids may be in the D- or L- optical configuration, though L-amino acids are generally the only type found in naturally-occurring proteins. Biosynthetic and degradative pathways of each of the 20 proteinogenic amino acids  
15   have been well characterized in both prokaryotic and eukaryotic cells (see, for example, Stryer, L. Biochemistry, 3<sup>rd</sup> edition, pages 578-590 (1988)). The 'essential' amino acids (histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine), so named because they are generally a nutritional requirement due to the complexity of their biosyntheses, are readily converted by simple biosynthetic pathways  
20   to the remaining 11 'nonessential' amino acids (alanine, arginine, asparagine, aspartate, cysteine, glutamate, glutamine, glycine, proline, serine, and tyrosine). Higher animals do retain the ability to synthesize some of these amino acids, but the essential amino acids must be supplied from the diet in order for normal protein synthesis to occur.

Aside from their function in protein biosynthesis, these amino acids are  
25   interesting chemicals in their own right, and many have been found to have various applications in the food, feed, chemical, cosmetics, agriculture, and pharmaceutical industries. Lysine is an important amino acid in the nutrition not only of humans, but also of monogastric animals such as poultry and swine. Glutamate is most commonly used as a flavor additive (mono-sodium glutamate, MSG) and is widely used throughout  
30   the food industry, as are aspartate, phenylalanine, glycine, and cysteine. Glycine, L-methionine and tryptophan are all utilized in the pharmaceutical industry. Glutamine, valine, leucine, isoleucine, histidine, arginine, proline, serine and alanine are of use in

both the pharmaceutical and cosmetics industries. Threonine, tryptophan, and D/ L-methionine are common feed additives. (Leuchtenberger, W. (1996) Amino acids – technical production and use, p. 466-502 in Rehm *et al.* (eds.) Biotechnology vol. 6, chapter 14a, VCH: Weinheim). Additionally, these amino acids have been found to be  
5 useful as precursors for the synthesis of synthetic amino acids and proteins, such as N-acetylcysteine, S-carboxymethyl-L-cysteine, (S)-5-hydroxytryptophan, and others described in Ulmann's Encyclopedia of Industrial Chemistry, vol. A2, p. 57-97, VCH: Weinheim, 1985.

The biosynthesis of these natural amino acids in organisms capable of  
10 producing them, such as bacteria, has been well characterized (for review of bacterial amino acid biosynthesis and regulation thereof, see Umbarger, H.E.(1978) *Ann. Rev. Biochem.* 47: 533-606). Glutamate is synthesized by the reductive amination of  $\alpha$ -ketoglutarate, an intermediate in the citric acid cycle. Glutamine, proline, and arginine are each subsequently produced from glutamate. The biosynthesis of serine is a three-  
15 step process beginning with 3-phosphoglycerate (an intermediate in glycolysis), and resulting in this amino acid after oxidation, transamination, and hydrolysis steps. Both cysteine and glycine are produced from serine; the former by the condensation of homocysteine with serine, and the latter by the transferal of the side-chain  $\beta$ -carbon atom to tetrahydrofolate, in a reaction catalyzed by serine transhydroxymethylase.  
20 Phenylalanine, and tyrosine are synthesized from the glycolytic and pentose phosphate pathway precursors erythrose 4-phosphate and phosphoenolpyruvate in a 9-step biosynthetic pathway that differ only at the final two steps after synthesis of prephenate. Tryptophan is also produced from these two initial molecules, but its synthesis is an 11-step pathway. Tyrosine may also be synthesized from phenylalanine, in a reaction  
25 catalyzed by phenylalanine hydroxylase. Alanine, valine, and leucine are all biosynthetic products of pyruvate, the final product of glycolysis. Aspartate is formed from oxaloacetate, an intermediate of the citric acid cycle. Asparagine, methionine, threonine, and lysine are each produced by the conversion of aspartate. Isoleucine is formed from threonine. A complex 9-step pathway results in the production of histidine  
30 from 5-phosphoribosyl-1-pyrophosphate, an activated sugar.

Amino acids in excess of the protein synthesis needs of the cell cannot be stored, and are instead degraded to provide intermediates for the major metabolic pathways of

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the cell (for review see Stryer, L. Biochemistry 3<sup>rd</sup> ed. Ch. 21 "Amino Acid Degradation and the Urea Cycle" p. 495-516 (1988)). Although the cell is able to convert unwanted amino acids into useful metabolic intermediates, amino acid production is costly in terms of energy, precursor molecules, and the enzymes necessary to synthesize them.

5 Thus it is not surprising that amino acid biosynthesis is regulated by feedback inhibition, in which the presence of a particular amino acid serves to slow or entirely stop its own production (for overview of feedback mechanisms in amino acid biosynthetic pathways, see Stryer, L. Biochemistry, 3<sup>rd</sup> ed. Ch. 24: "Biosynthesis of Amino Acids and Heme" p. 575-600 (1988)). Thus, the output of any particular amino acid is limited by the amount

10 of that amino acid present in the cell.

#### *B. Vitamin, Cofactor, and Nutraceutical Metabolism and Uses*

Vitamins, cofactors, and nutraceuticals comprise another group of molecules which the higher animals have lost the ability to synthesize and so must ingest, although

15 they are readily synthesized by other organisms, such as bacteria. These molecules are either bioactive substances themselves, or are precursors of biologically active substances which may serve as electron carriers or intermediates in a variety of metabolic pathways. Aside from their nutritive value, these compounds also have significant industrial value as coloring agents, antioxidants, and catalysts or other

20 processing aids. (For an overview of the structure, activity, and industrial applications of these compounds, see, for example, Ullman's Encyclopedia of Industrial Chemistry, "Vitamins" vol. A27, p. 443-613, VCH: Weinheim, 1996.) The term "vitamin" is art-recognized, and includes nutrients which are required by an organism for normal functioning, but which that organism cannot synthesize by itself. The group of vitamins

25 may encompass cofactors and nutraceutical compounds. The language "cofactor" includes nonproteinaceous compounds required for a normal enzymatic activity to occur. Such compounds may be organic or inorganic; the cofactor molecules of the invention are preferably organic. The term "nutraceutical" includes dietary supplements having health benefits in plants and animals, particularly humans. Examples of such

30 molecules are vitamins, antioxidants, and also certain lipids (e.g., polyunsaturated fatty acids).

The biosynthesis of these molecules in organisms capable of producing them, such as bacteria, has been largely characterized (Ullman's Encyclopedia of Industrial Chemistry, "Vitamins" vol. A27, p. 443-613, VCH: Weinheim, 1996; Michal, G. (1999) Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology, John Wiley & Sons; Ong, A.S., Niki, E. & Packer, L. (1995) "Nutrition, Lipids, Health, and Disease" Proceedings of the UNESCO/Confederation of Scientific and Technological Associations in Malaysia, and the Society for Free Radical Research – Asia, held Sept. 1-3, 1994 at Penang, Malaysia, AOCS Press: Champaign, IL X, 374 S).

Thiamin (vitamin B<sub>1</sub>) is produced by the chemical coupling of pyrimidine and thiazole moieties. Riboflavin (vitamin B<sub>2</sub>) is synthesized from guanosine-5'-triphosphate (GTP) and ribose-5'-phosphate. Riboflavin, in turn, is utilized for the synthesis of flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD). The family of compounds collectively termed 'vitamin B<sub>6</sub>' (*e.g.*, pyridoxine, pyridoxamine, pyridoxal-5'-phosphate, and the commercially used pyridoxin hydrochloride) are all derivatives of the common structural unit, 5-hydroxy-6-methylpyridine. Pantothenate (pantothenic acid, (R)-(+)-N-(2,4-dihydroxy-3,3-dimethyl-1-oxobutyl)- $\beta$ -alanine) can be produced either by chemical synthesis or by fermentation. The final steps in pantothenate biosynthesis consist of the ATP-driven condensation of  $\beta$ -alanine and pantoic acid. The enzymes responsible for the biosynthesis steps for the conversion to pantoic acid, to  $\beta$ -alanine and for the condensation to pantothenic acid are known. The metabolically active form of pantothenate is Coenzyme A, for which the biosynthesis proceeds in 5 enzymatic steps. Pantothenate, pyridoxal-5'-phosphate, cysteine and ATP are the precursors of Coenzyme A. These enzymes not only catalyze the formation of pantothenate, but also the production of (R)-pantoic acid, (R)-pantolacton, (R)-panthenol (provitamin B<sub>5</sub>), pantetheine (and its derivatives) and coenzyme A.

Biotin biosynthesis from the precursor molecule pimeloyl-CoA in microorganisms has been studied in detail and several of the genes involved have been identified. Many of the corresponding proteins have been found to also be involved in Fe-cluster synthesis and are members of the nifS class of proteins. Lipoic acid is derived from octanoic acid, and serves as a coenzyme in energy metabolism, where it becomes part of the pyruvate dehydrogenase complex and the  $\alpha$ -ketoglutarate dehydrogenase complex. The folates are a group of substances which are all derivatives



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of folic acid, which is turn is derived from L-glutamic acid, p-amino-benzoic acid and 6-methylpterin. The biosynthesis of folic acid and its derivatives, starting from the metabolism intermediates guanosine-5'-triphosphate (GTP), L-glutamic acid and p-amino-benzoic acid has been studied in detail in certain microorganisms.

5           Corrinoids (such as the cobalamines and particularly vitamin B<sub>12</sub>) and porphyrines belong to a group of chemicals characterized by a tetrapyrrole ring system. The biosynthesis of vitamin B<sub>12</sub> is sufficiently complex that it has not yet been completely characterized, but many of the enzymes and substrates involved are now known. Nicotinic acid (nicotinate), and nicotinamide are pyridine derivatives which are  
10 also termed 'niacin'. Niacin is the precursor of the important coenzymes NAD (nicotinamide adenine dinucleotide) and NADP (nicotinamide adenine dinucleotide phosphate) and their reduced forms.

The large-scale production of these compounds has largely relied on cell-free chemical syntheses, though some of these chemicals have also been produced by large-  
15 scale culture of microorganisms, such as riboflavin, Vitamin B<sub>6</sub>, pantothenate, and biotin. Only Vitamin B<sub>12</sub> is produced solely by fermentation, due to the complexity of its synthesis. *In vitro* methodologies require significant inputs of materials and time, often at great cost.

#### 20   C. Purine, Pyrimidine, Nucleoside and Nucleotide Metabolism and Uses

Purine and pyrimidine metabolism genes and their corresponding proteins are important targets for the therapy of tumor diseases and viral infections. The language "purine" or "pyrimidine" includes the nitrogenous bases which are constituents of nucleic acids, co-enzymes, and nucleotides. The term "nucleotide" includes the basic  
25 structural units of nucleic acid molecules, which are comprised of a nitrogenous base, a pentose sugar (in the case of RNA, the sugar is ribose; in the case of DNA, the sugar is D-deoxyribose), and phosphoric acid. The language "nucleoside" includes molecules which serve as precursors to nucleotides, but which are lacking the phosphoric acid moiety that nucleotides possess. By inhibiting the biosynthesis of these molecules, or  
30 their mobilization to form nucleic acid molecules, it is possible to inhibit RNA and DNA synthesis; by inhibiting this activity in a fashion targeted to cancerous cells, the ability of tumor cells to divide and replicate may be inhibited. Additionally, there are

nucleotides which do not form nucleic acid molecules, but rather serve as energy stores (*i.e.*, AMP) or as coenzymes (*i.e.*, FAD and NAD).

Several publications have described the use of these chemicals for these medical indications, by influencing purine and/or pyrimidine metabolism (*e.g.* Christopherson, R.I. and Lyons, S.D. (1990) "Potent inhibitors of *de novo* pyrimidine and purine biosynthesis as chemotherapeutic agents." *Med. Res. Reviews* 10: 505-548). Studies of enzymes involved in purine and pyrimidine metabolism have been focused on the development of new drugs which can be used, for example, as immunosuppressants or anti-proliferants (Smith, J.L., (1995) "Enzymes in nucleotide synthesis." *Curr. Opin. Struct. Biol.* 5: 752-757; (1995) *Biochem Soc. Transact.* 23: 877-902). However, purine and pyrimidine bases, nucleosides and nucleotides have other utilities: as intermediates in the biosynthesis of several fine chemicals (*e.g.*, thiamine, S-adenosyl-methionine, folates, or riboflavin), as energy carriers for the cell (*e.g.*, ATP or GTP), and for chemicals themselves, commonly used as flavor enhancers (*e.g.*, IMP or GMP) or for several medicinal applications (see, for example, Kuninaka, A. (1996) *Nucleotides and Related Compounds in Biotechnology* vol. 6, Rehm *et al.*, eds. VCH: Weinheim, p. 561-612). Also, enzymes involved in purine, pyrimidine, nucleoside, or nucleotide metabolism are increasingly serving as targets against which chemicals for crop protection, including fungicides, herbicides and insecticides, are developed.

The metabolism of these compounds in bacteria has been characterized (for reviews see, for example, Zalkin, H. and Dixon, J.E. (1992) "*de novo* purine nucleotide biosynthesis", in: *Progress in Nucleic Acid Research and Molecular Biology*, vol. 42, Academic Press; p. 259-287; and Michal, G. (1999) "Nucleotides and Nucleosides", Chapter 8 in: *Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology*, Wiley: New York). Purine metabolism has been the subject of intensive research, and is essential to the normal functioning of the cell. Impaired purine metabolism in higher animals can cause severe disease, such as gout. Purine nucleotides are synthesized from ribose-5-phosphate, in a series of steps through the intermediate compound inosine-5'-phosphate (IMP), resulting in the production of guanosine-5'-monophosphate (GMP) or adenosine-5'-monophosphate (AMP), from which the triphosphate forms utilized as nucleotides are readily formed. These compounds are also utilized as energy stores, so their degradation provides energy for many different biochemical processes in the cell.

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Pyrimidine biosynthesis proceeds by the formation of uridine-5'-monophosphate (UMP) from ribose-5-phosphate. UMP, in turn, is converted to cytidine-5'-triphosphate (CTP). The deoxy- forms of all of these nucleotides are produced in a one step reduction reaction from the diphosphate ribose form of the nucleotide to the diphosphate deoxyribose form of the nucleotide. Upon phosphorylation, these molecules are able to participate in DNA synthesis.

#### *D. Trehalose Metabolism and Uses*

Trehalose consists of two glucose molecules, bound in  $\alpha$ ,  $\alpha$ -1,1 linkage. It is commonly used in the food industry as a sweetener, an additive for dried or frozen foods, and in beverages. However, it also has applications in the pharmaceutical, cosmetics and biotechnology industries (see, for example, Nishimoto *et al.*, (1998) U.S. Patent No. 5,759,610; Singer, M.A. and Lindquist, S. (1998) *Trends Biotech.* 16: 460-467; Paiva, C.L.A. and Panek, A.D. (1996) *Biotech. Ann. Rev.* 2: 293-314; and Shiosaka, M. (1997) *J. Japan* 172: 97-102). Trehalose is produced by enzymes from many microorganisms and is naturally released into the surrounding medium, from which it can be collected using methods known in the art.

## II. Resistance to Damage from Chemicals, Environmental Stress, and Antibiotics

Production of fine chemicals is typically performed by large-scale culture of bacteria developed to produce and secrete large quantities of these molecules. However, this type of large-scale fermentation results in the subjection of the microorganisms to stresses of various kinds. These stresses include environmental stress and chemical stress.

#### *A. Resistance to Environmental Stress*

Examples of environmental stresses typically encountered in large-scale fermentative culture include mechanical stress, heat stress, stress due to limited oxygen, stress due to oxygen radicals, pH stress, and osmotic stress. The stirring mechanism used in most large-scale fermentors to ensure aeration of the culture produces heat, thus increasing the temperature of the culture. Increases in temperature induce the well-characterized heat shock response, in which a set of proteins are expressed which not

only aid in the survival of the bacterium in the face of high temperatures, but also increase survival in response to a number of other environmental stresses (see Neidhardt, F.C., *et al.*, eds. (1996) *E. coli* and *Salmonella*. ASM Press: Washington, D.C., p. 1382-1399; Wosten, M. M. (1998) *FEMS Microbiology Reviews* 22(3): 127-50; 5 Bahl, H. *et al.* (1995) *FEMS Microbiology Reviews* 17(3): 341-348; Zimmerman, J.L., Cohill, P.R. (1991) *New Biologist* 3(7): 641-650; Samali, A., and Orrenius, S. (1998) *Cell. Stress Chaperones* 3(4): 228-236, and references contained therein from each of these citations). Regulation of the heat shock response in bacteria is facilitated by specific sigma factors and other cellular regulators of gene expression (Hecker, M., 10 Volker, U (1998). *Molecular Microbiology* 29(5): 1129-1136). One of the largest problems that the cell encounters when exposed to high temperature is that protein folding is impaired; nascent proteins have sufficient kinetic energy in high temperature circumstances that it is difficult for the growing polypeptide chain to remain in a stable conformation long enough to fold properly. Thus, two of the key types of proteins 15 expressed during the heat shock response consist of chaperones (proteins which assist in the folding or unfolding of other proteins – see, *e.g.*, Fink, A.L. (1999) *Physiol. Rev.* 79(2): 425-449), and proteases, which can destroy any improperly folded proteins. Examples of chaperones expressed during the heat shock response include GroEL and DNAK; proteases known to be expressed during this cellular reaction to heat shock 20 include Lon, FtsH, and ClpB.

Other environmental stresses besides heat may also provoke a stress response. Though the fermentor stirring process is meant to introduce oxygen into the culture, oxygen may remain in limited supply, particularly when the culture is advanced in growth and the oxygen needs of the culture are thereby increased; an insufficient supply 25 of oxygen is another stress for the microorganism. Cells in fermentor cultures are also subjected to a number of osmotic stresses, particularly when nutrients are added to the culture, resulting in a high extracellular and low intracellular concentration of these molecules. Further, the large quantities of the desired molecules produced by these organisms in culture may contribute to osmotic stress of the bacteria. Lastly, aerobic 30 metabolism such as that used by *C. glutamicum* results in carbon dioxide as a waste product; secretion of this molecule may acidify the culture medium due to conversion of this molecule to carboxylic acid. Thus, bacteria in culture are also frequently subjected



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to acidic pH stress. The converse may also be true – when high levels of basic waste molecules such as ammonium are present in the culture medium, the bacteria in culture may be subjected to basic pH stress as well.

To combat such environmental stresses, bacteria have elegant gene systems  
5 which are expressed upon exposure to one or more stresses, such as the aforementioned heat shock system. Genes expressed in response to osmotic stress, for example, encode proteins capable of transporting or synthesizing compatible solutes such that osmotic intake or export of a particular molecule is slowed to manageable levels. Other examples of stress-induced bacterial proteins are those involved in trehalose biosynthesis, those  
10 encoding enzymes involved in ppGpp metabolism, those involved in signal transduction, particularly those encoding two-component systems which are sensitive to osmotic pressure, and those encoding transcription factors which are responsive to a variety of stress factors (*e.g.*, RssB analogues and/or sigma factors). Many other such genes and their protein products are known in the art.

15

#### *B. Resistance to Chemical Stress*

Aside from environmental stresses, cells may also experience a number of chemical stresses. These may fall into two categories. The first are natural waste products of metabolism and other cellular processes which are secreted by the cell to the  
20 surrounding medium. The second are chemicals present in the extracellular medium which do not originate from the cell. Generally, when cells excrete toxic waste products from the concentrated intracellular cytoplasm into the relatively much more dilute extracellular medium, these products dissipate such that extracellular levels of the possibly toxic compound are quite low. However, in large-scale fermentative culture of  
25 the bacterium, this may not be the case: so many bacteria are grown in a relatively small environment and at such a high metabolic rate that waste products may accumulate in the medium to nearly toxic levels. Examples of such wastes are carbon dioxide, metal ions, and reactive oxygen species such as hydrogen peroxide. These compounds may interfere with the activity or structure of cell surface molecules, or may re-enter the cell,  
30 where they can seriously damage proteins and nucleic acids alike. Certain other chemicals hazardous to the normal functioning of cells may be naturally found in the extracellular medium. For example, metal ions such as mercury, cadmium, nickel or

copper are frequently found in water sources, and may form tight complexes with cellular enzymes which prevent the normal functioning of these proteins.

### C. Resistance to Antibiotics

5 Bacteriocidal proteins or antibiotics, may also be found in the extracellular milieu, either through the intervention of the researcher, or as a natural product from another organism, utilized to gain a competitive advantage. Microorganisms have several art-known mechanisms to protect themselves against antimicrobial chemicals. Degradation, modification, and export of compounds toxic to the cell are common  
10 methods by which microorganisms eliminate or detoxify antibiotics. Cytoplasmic 'efflux-pumps' are known in several prokaryotes and show similarities to the so-called 'multidrug resistance' proteins from higher eukaryotes (Neyfakh, A. A. , *et al.* (1991) *Proc. Natl. Acad. Sci. USA* 88: 4781-4785). Examples of such proteins include emrAB from *E. coli* (Lomovskaya, O. and K. Lewis (1992) *Proc. Natl. Acad. Sci. USA* 89:  
15 8938-8942), lmrB from *B. subtilis* (Kumano, M. *et al.* (1997) *Microbiology* 143: 2775-2782), smr from *S. aureus* (Grinius, L.G. *et al.* (1992) *Plasmid* 27: 119-129) or cmr from *C. glutamicum* (Kaidoh, K. *et al.* (1997) *Micro. Drug Resist.* 3: 345-350). *C. glutamicum* itself is non-pathogenic, in contrast to several other members of the genus *Corynebacterium* , such as *C. diphtheriae* or *C. pseudotuberculosis*. Several pathogenic  
20 *Corynebacteria* are known to have multiple resistances against a variety of antibiotics, such as *C. jeikeium* and *C. urealyticum* (Soriano, F. *et al.* (1995) *Antimicrob. Agents Chemother.* 39: 208-214).

Lincosamides are recognized as effective antibiotics against *Corynebacterium* species (Soriano, F. *et al.* (1995) *Antimicrob. Agents Chemother.* 39: 208-214). An  
25 unexpected result of the present invention was the identification of a gene encoding a lincosamide-resistance protein (in particular, a lincomycin-resistance protein). The LMRB protein from *C. glutamicum* shows 40% homology to the product of the lmrB gene from *B. subtilis* (see Genbank accession no. AL009126), as calculated using version 1.7 of the program CLUSTALW (Thompson, J.D., Higgins, D.G., Gibson, T. J. (1994) *Nucl. Acids Res.* 22: 4673-4680) using standard parameters (PAIRWISE  
30 ALIGNMENT PARAMETERS: slow/accurate alignments: Gap Open Penalty = 10.00, Gap Extension Penalty = 0.10, Protein weight matrix = BLOSUM 30, DNA weight

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matrix = IUB, Fast/Approximate alignments: Gap penalty = 3, K-tuple (word) size = 1, No. of top diagonals = 5, Window size = 5, Toggle Slow/Fast pairwise alignments = slow. Multiple alignment parameters: Gap Opening Penalty = 10.00, Gap Extension Penalty = 0.05, Delay divergent sequences = 40%, DNA transitions weight = 0.50, 5 Protein weight matrix = BLOSUM series, DNA weight matrix = IUB, Use negative matrix = OFF).

Environmental stress, chemical stress, and antibiotic or other antimicrobial stress may influence the behavior of the microorganisms during fermentor culture, and may have an impact on the production of the desired compound from these organisms. 10 For example, osmotic stress of a microorganism may cause inappropriate or inappropriately rapid uptake of one or more compounds which can ultimately lead to cellular damage or death due to osmotic shock. Similarly, chemicals present in the culture, either exogenously added (*e.g.*, antimicrobial compounds intended to eliminate unwanted microbes) or generated by the bacteria themselves (*e.g.*, waste compounds 15 such as heavy metals or oxygen radicals, or even antimicrobial compounds) may result in inhibition of fine chemical production or even death of the organism. The genes of the invention encode *C. glutamicum* proteins which act to prevent cell damage or death, by specifically counteracting the source or effect of the environmental or chemical stress.

20

### III. Elements and Methods of the Invention

The present invention is based, at least in part, on the discovery of novel molecules, referred to herein as SRT nucleic acid and protein molecules, which increase the ability of *C. glutamicum* to survive in chemically or environmentally hazardous 25 settings. In one embodiment, the SRT molecules function to confer resistance to one or more environmental or chemical stresses to *C. glutamicum*. In a preferred embodiment, the activity of the SRT molecules of the present invention has an impact on the production of a desired fine chemical by this organism. In a particularly preferred embodiment, the SRT molecules of the invention are modulated in activity, such that the 30 yield, production, and/or efficiency of production of one or more fine chemicals from *C. glutamicum* is also modulated.

The language, "SRT protein" or "SRT polypeptide" includes proteins which participate in the resistance of *C. glutamicum* to one or more environmental or chemical stresses. Examples of SRT proteins include those encoded by the SRT genes set forth in Table 1 and by the odd-numbered SEQ ID NOs. The terms "SRT gene" or "SRT  
5 nucleic acid sequence" include nucleic acid sequences encoding an SRT protein, which consist of a coding region and also corresponding untranslated 5' and 3' sequence regions. Examples of SRT genes include those set forth in Table 1. The terms "production" or "productivity" are art-recognized and include the concentration of the fermentation product (for example, the desired fine chemical) formed within a given  
10 time and a given fermentation volume (e.g., kg product per hour per liter). The term "efficiency of production" includes the time required for a particular level of production to be achieved (for example, how long it takes for the cell to attain a particular rate of output of a fine chemical). The term "yield" or "product/carbon yield" is art-recognized and includes the efficiency of the conversion of the carbon source into the product (i.e.,  
15 fine chemical). This is generally written as, for example, kg product per kg carbon source. By increasing the yield or production of the compound, the quantity of recovered molecules, or of useful recovered molecules of that compound in a given amount of culture over a given amount of time is increased. The terms "biosynthesis" or a "biosynthetic pathway" are art-recognized and include the synthesis of a compound,  
20 preferably an organic compound, by a cell from intermediate compounds in what may be a multistep and highly regulated process. The terms "degradation" or a "degradation pathway" are art-recognized and include the breakdown of a compound, preferably an organic compound, by a cell to degradation products (generally speaking, smaller or less complex molecules) in what may be a multistep and highly regulated process. The  
25 language "metabolism" is art-recognized and includes the totality of the biochemical reactions that take place in an organism. The metabolism of a particular compound, then, (e.g., the metabolism of an amino acid such as glycine) comprises the overall biosynthetic, modification, and degradation pathways in the cell related to this compound. The terms "resistance" and "tolerance" are art-known and include the ability  
30 of a cell to not be affected by exposure to a chemical or an environment which would otherwise be detrimental to the normal functioning of these organisms. The terms "stress" or "hazard" include factors which are detrimental to the normal functioning of

cells such as *C. glutamicum*. Examples of stresses include “chemical stress”, in which a cell is exposed to one or more chemicals which are detrimental to the cell, and “environmental stress” where a cell is exposed to an environmental condition outside of those to which it is adapted. Chemical stresses may be either natural metabolic waste products such as, but not limited to reactive oxygen species or carbon dioxide, or chemicals otherwise present in the environment, including, but not limited to heavy metal ions or bacteriocidal proteins such as antibiotics. Environmental stresses may be, but are not limited to temperatures outside of the normal range, suboptimal oxygen availability, osmotic pressures, or extremes of pH, for example.

10 In another embodiment, the SRT molecules of the invention are capable of modulating the production of a desired molecule, such as a fine chemical, in a microorganism such as *C. glutamicum*. Using recombinant genetic techniques, one or more of the SRT proteins of the invention may be manipulated such that its function is modulated. The alteration of activity of stress response, resistance or tolerance genes  
15 such that the cell is increased in tolerance to one or more stresses may improve the ability of that cell to grow and multiply in the relatively stressful conditions of large-scale fermentor culture. For example, by overexpressing or engineering a heat-shock induced chaperone molecule such that it is optimized in activity, one may increase the ability of the bacterium to correctly fold proteins in the face of nonoptimal temperature  
20 conditions. By having fewer misfolded (and possibly misregulated or nonfunctional) proteins, the cell is increased in its ability to function normally in such a culture, which should in turn provide increased viability. This overall increase in number of cells having greater viability and activity in the culture should also result in an increase in the yield, production, and/or efficiency of production of one or more desired fine chemicals,  
25 due at least to the relatively greater number of cells producing these chemicals in the culture.

The isolated nucleic acid sequences of the invention are contained within the genome of a *Corynebacterium glutamicum* strain available through the American Type Culture Collection, given designation ATCC 13032. The nucleotide sequence of the  
30 isolated *C. glutamicum* SRT DNAs and the predicted amino acid sequences of the *C. glutamicum* SRT proteins are shown the Sequence Listing as odd-numbered SEQ ID NOs and even-numbered SEQ ID NOs, respectively.,.



Computational analyses were performed which classified and/or identified these nucleotide sequences as sequences which encode chemical and environmental stress, resistance, and tolerance proteins.

The present invention also pertains to proteins which have an amino acid  
5 sequence which is substantially homologous to an amino acid sequence of the invention (e.g., the sequence of an even-numbered SEQ ID NO of the Sequence Listing). As used herein, a protein which has an amino acid sequence which is substantially homologous to a selected amino acid sequence is least about 50% homologous to the selected amino acid sequence, e.g., the entire selected amino acid sequence. A protein which has an  
10 amino acid sequence which is substantially homologous to a selected amino acid sequence can also be least about 50-60%, preferably at least about 60-70%, and more preferably at least about 70-80%, 80-90%, or 90-95%, and most preferably at least about 96%, 97%, 98%, 99% or more homologous to the selected amino acid sequence. Ranges and identity values intermediate to the above-recited values, (e.g., 75%-80%  
15 identical, 85-87% identical, 91-92% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower limits are intended to be included.

The SRT proteins or biologically active portions or fragments thereof of the invention can confer resistance or tolerance to one or more chemical or environmental  
20 stresses, or may have one or more of the activities set forth in Table 1.

Various aspects of the invention are described in further detail in the following subsections:

#### *A. Isolated Nucleic Acid Molecules*

25 One aspect of the invention pertains to isolated nucleic acid molecules that encode SRT polypeptides or biologically active portions thereof, as well as nucleic acid fragments sufficient for use as hybridization probes or primers for the identification or amplification of SRT-encoding nucleic acid (e.g., SRT DNA). As used herein, the term "nucleic acid molecule" is intended to include DNA molecules (e.g., cDNA or genomic  
30 DNA) and RNA molecules (e.g., mRNA) and analogs of the DNA or RNA generated using nucleotide analogs. This term also encompasses untranslated sequence located at both the 3' and 5' ends of the coding region of the gene: at least about 100 nucleotides

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of sequence upstream from the 5' end of the coding region and at least about 20 nucleotides of sequence downstream from the 3' end of the coding region of the gene. The nucleic acid molecule can be single-stranded or double-stranded, but preferably is double-stranded DNA. An "isolated" nucleic acid molecule is one which is separated  
5 from other nucleic acid molecules which are present in the natural source of the nucleic acid. Preferably, an "isolated" nucleic acid is free of sequences which naturally flank the nucleic acid (*i.e.*, sequences located at the 5' and 3' ends of the nucleic acid) in the genomic DNA of the organism from which the nucleic acid is derived. For example, in various embodiments, the isolated SRT nucleic acid molecule can contain less than  
10 about 5 kb, 4kb, 3kb, 2kb, 1 kb, 0.5 kb or 0.1 kb of nucleotide sequences which naturally flank the nucleic acid molecule in genomic DNA of the cell from which the nucleic acid is derived (*e.g.*, a *C. glutamicum* cell). Moreover, an "isolated" nucleic acid molecule, such as a DNA molecule, can be substantially free of other cellular material, or culture medium when produced by recombinant techniques, or chemical precursors or  
15 other chemicals when chemically synthesized.

A nucleic acid molecule of the present invention, *e.g.*, a nucleic acid molecule having a nucleotide sequence of an odd-numbered SEQ ID NO of the Sequence Listing, or a portion thereof, can be isolated using standard molecular biology techniques and the sequence information provided herein. For example, a *C. glutamicum* SRT DNA can be  
20 isolated from a *C. glutamicum* library using all or portion of one of the odd-numbered SEQ ID NO sequences of the Sequence Listing as a hybridization probe and standard hybridization techniques (*e.g.*, as described in Sambrook, J., Fritsh, E. F., and Maniatis, T. *Molecular Cloning: A Laboratory Manual*. 2nd, ed., Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989).  
25 Moreover, a nucleic acid molecule encompassing all or a portion of one of the nucleic acid sequences of the invention (*e.g.*, an odd-numbered SEQ ID NO:) can be isolated by the polymerase chain reaction using oligonucleotide primers designed based upon this sequence (*e.g.*, a nucleic acid molecule encompassing all or a portion of one of the nucleic acid sequences of the invention (*e.g.*, an odd-numbered SEQ ID NO of the  
30 Sequence Listing) can be isolated by the polymerase chain reaction using oligonucleotide primers designed based upon this same sequence). For example, mRNA can be isolated from normal endothelial cells (*e.g.*, by the guanidinium-thiocyanate

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extraction procedure of Chirgwin *et al.* (1979) *Biochemistry* 18: 5294-5299) and DNA can be prepared using reverse transcriptase (*e.g.*, Moloney MLV reverse transcriptase, available from Gibco/BRL, Bethesda, MD; or AMV reverse transcriptase, available from Seikagaku America, Inc., St. Petersburg, FL). Synthetic oligonucleotide primers  
5 for polymerase chain reaction amplification can be designed based upon one of the nucleotide sequences shown in the Sequence Listing. A nucleic acid of the invention can be amplified using cDNA or, alternatively, genomic DNA, as a template and appropriate oligonucleotide primers according to standard PCR amplification techniques. The nucleic acid so amplified can be cloned into an appropriate vector and  
10 characterized by DNA sequence analysis. Furthermore, oligonucleotides corresponding to an SRT nucleotide sequence can be prepared by standard synthetic techniques, *e.g.*, using an automated DNA synthesizer.

In a preferred embodiment, an isolated nucleic acid molecule of the invention comprises one of the nucleotide sequences shown in the Sequence Listing. The nucleic  
15 acid sequences of the invention, as set forth in the Sequence Listing, correspond to the *Corynebacterium glutamicum* SRT DNAs of the invention. This DNA comprises sequences encoding SRT proteins (*i.e.*, the "coding region", indicated in each odd-numbered SEQ ID NO: sequence in the Sequence Listing), as well as 5' untranslated sequences and 3' untranslated sequences, also indicated in each odd-numbered SEQ ID  
20 NO: in the Sequence Listing. Alternatively, the nucleic acid molecule can comprise only the coding region of any of the nucleic acid sequences of the Sequence Listing.

For the purposes of this application, it will be understood that each of the nucleic acid and amino acid sequences set forth in the Sequence Listing has an identifying RXA, RXN, or RXS number having the designation "RXA", "RXN", or "RXS" followed by 5  
25 digits (*i.e.*, RXA01524, RXN00493, or RXS01027). Each of the nucleic acid sequences comprises up to three parts: a 5' upstream region, a coding region, and a downstream region. Each of these three regions is identified by the same RXA, RXN, or RXS designation to eliminate confusion. The recitation "one of the odd-numbered sequences of the Sequence Listing", then, refers to any of the nucleic acid sequences in the  
30 Sequence Listing, which may be also be distinguished by their differing RXA, RXN, or RXS designations. The coding region of each of these sequences is translated into a corresponding amino acid sequence, which is also set forth in the Sequence Listing, as an

even-numbered SEQ ID NO: immediately following the corresponding nucleic acid sequence. For example, the coding region for RXA01524 is set forth in SEQ ID NO:1, while the amino acid sequence which it encodes is set forth as SEQ ID NO:2. The sequences of the nucleic acid molecules of the invention are identified by the same  
5 RXA, RXN, or RXS designations as the amino acid molecules which they encode, such that they can be readily correlated. For example, the amino acid sequence designated RXA01524 is a translation of the coding region of the nucleotide sequence of nucleic acid molecule RXA01524, the amino acid sequence designated RXN00034 is a translation of the coding region of the nucleotide sequence of nucleic acid molecule  
10 RXN00034, and the amino acid sequence in designated RXS00568 is a translation of the coding region of the nucleotide sequence of nucleic acid molecule RXS00568. The correspondence between the RXA, RXN, and RXS nucleotide and amino acid sequences of the invention and their assigned SEQ ID NOs is set forth in Table 1.

Several of the genes of the invention are "F-designated genes". An F-designated  
15 gene includes those genes set forth in Table 1 which have an 'F' in front of the RXA, RXN, or RXS designation. For example, SEQ ID NO:7, designated, as indicated on Table 1, as "F RXA00498", is an F-designated gene, as are SEQ ID NOs: 25, 33, and 37 (designated on Table 1 as "F RXA01345", "F RXA02543", and "F RXA02282", respectively).

20 In one embodiment, the nucleic acid molecules of the present invention are not intended to include those compiled in Table 2. In the case of the *dapD* gene, a sequence for this gene was published in Wehrmann, A., *et al.* (1998) *J. Bacteriol.* 180(12): 3159-3165. However, the sequence obtained by the inventors of the present application is significantly longer than the published version. It is believed that the published version  
25 relied on an incorrect start codon, and thus represents only a fragment of the actual coding region.

In another preferred embodiment, an isolated nucleic acid molecule of the invention comprises a nucleic acid molecule which is a complement of one of the nucleotide sequences of the invention (*e.g.*, a sequence of an odd-numbered SEQ ID  
30 NO: of the Sequence Listing, or a portion thereof. A nucleic acid molecule which is complementary to one of the nucleotide sequences of the invention is one which is sufficiently complementary to one of the nucleotide sequences shown in the Sequence

Listing (e.g., the sequence of an odd-numbered SEQ ID NO:) such that it can hybridize to one of the nucleotide sequences of the invention, thereby forming a stable duplex.

In still another preferred embodiment, an isolated nucleic acid molecule of the invention comprises a nucleotide sequence which is at least about 50%, 51%, 52%, 53%,  
5 54%, 55%, 56%, 57%, 58%, 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to a nucleotide sequence of the  
10 invention (e.g., a sequence of an odd-numbered SEQ ID NO: of the Sequence Listing), or a portion thereof. Ranges and identity values intermediate to the above-recited ranges, (e.g., 70-90% identical or 80-95% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower limits are intended to be included. In an  
15 additional preferred embodiment, an isolated nucleic acid molecule of the invention comprises a nucleotide sequence which hybridizes, e.g., hybridizes under stringent conditions, to one of the nucleotide sequences of the invention,, or a portion thereof.

Moreover, the nucleic acid molecule of the invention can comprise only a portion of the coding region of the sequence of one of the odd-numbered SEQ ID NOs  
20 of the Sequence Listing for example a fragment which can be used as a probe or primer or a fragment encoding a biologically active portion of an SRT protein. The nucleotide sequences determined from the cloning of the SRT genes from *C. glutamicum* allows for the generation of probes and primers designed for use in identifying and/or cloning SRT homologues in other cell types and organisms, as well as SRT homologues from other  
25 *Corynebacteria* or related species. The probe/primer typically comprises substantially purified oligonucleotide. The oligonucleotide typically comprises a region of nucleotide sequence that hybridizes under stringent conditions to at least about 12, preferably about 25, more preferably about 40, 50 or 75 consecutive nucleotides of a sense strand of one of the nucleotide sequences of the invention (e.g., a sequence of one of the odd-  
30 numbered SEQ ID NOs of the Sequence Listing),, an anti-sense sequence of one of these sequences, or naturally occurring mutants thereof. Primers based on a nucleotide sequence of the invention can be used in PCR reactions to clone SRT homologues.



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Probes based on the SRT nucleotide sequences can be used to detect transcripts or genomic sequences encoding the same or homologous proteins. In preferred embodiments, the probe further comprises a label group attached thereto, *e.g.* the label group can be a radioisotope, a fluorescent compound, an enzyme, or an enzyme co-  
5 factor. Such probes can be used as a part of a diagnostic test kit for identifying cells which misexpress an SRT protein, such as by measuring a level of an SRT-encoding nucleic acid in a sample of cells, *e.g.*, detecting SRT mRNA levels or determining whether a genomic SRT gene has been mutated or deleted.

In one embodiment, the nucleic acid molecule of the invention encodes a protein  
10 or portion thereof which includes an amino acid sequence which is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO of the Sequence Listing) such that the protein or portion thereof maintains the ability to confer resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses. As used herein, the language "sufficiently  
15 homologous" refers to proteins or portions thereof which have amino acid sequences which include a minimum number of identical or equivalent (*e.g.*, an amino acid residue which has a similar side chain as an amino acid residue in a sequence of one of the even-numbered SEQ ID NOs of the Sequence Listing) amino acid residues to an amino acid sequence of the invention such that the protein or portion thereof is capable of  
20 participating in the resistance of *C. glutamicum* to one or more chemical or environmental stresses. Protein members of such metabolic pathways, as described herein, function to increase the resistance or tolerance of *C. glutamicum* to one or more environmental or chemical hazards or stresses. Examples of such activities are also described herein. Thus, "the function of an SRT protein" contributes to the overall  
25 resistance of *C. glutamicum* to elements of its surroundings which may impede its normal growth or functioning, and/or contributes, either directly or indirectly, to the yield, production, and/or efficiency of production of one or more fine chemicals. Examples of SRT protein activities are set forth in Table 1.

In another embodiment, the protein is at least about 50-60%, preferably at least  
30 about 60-70%, and more preferably at least about 70-80%, 80-90%, 90-95%, and most preferably at least about 96%, 97%, 98%, 99% or more homologous to an entire amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of

the Sequence Listing). Ranges and identity values intermediate to the above-recited values, (e.g., 75%-80% identical, 85-87% identical, or 91-92% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower  
5 limits are intended to be included.

Portions of proteins encoded by the SRT nucleic acid molecules of the invention are preferably biologically active portions of one of the SRT proteins. As used herein, the term "biologically active portion of an SRT protein" is intended to include a portion, e.g., a domain/motif, of an SRT protein that is capable of imparting resistance or  
10 tolerance to one or more environmental or chemical stresses or hazards, or has an activity as set forth in Table 1. To determine whether an SRT protein or a biologically active portion thereof can increase the resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses or hazards, an assay of enzymatic activity may be performed. Such assay methods are well known to those of ordinary skill in the art, as  
15 detailed in Example 8 of the Exemplification.

Additional nucleic acid fragments encoding biologically active portions of an SRT protein can be prepared by isolating a portion of one of the amino acid sequences of the invention (e.g., a sequence of an even-numbered SEQ ID NO: of the Sequence Listing), expressing the encoded portion of the SRT protein or peptide (e.g., by  
20 recombinant expression *in vitro*) and assessing the activity of the encoded portion of the SRT protein or peptide.

The invention further encompasses nucleic acid molecules that differ from one of the nucleotide sequences of the invention (e.g., a sequence of an odd-numbered SEQ ID NO: of the Sequence Listing) (and portions thereof) due to degeneracy of the genetic  
25 code and thus encode the same SRT protein as that encoded by the nucleotide sequences of the invention. In another embodiment, an isolated nucleic acid molecule of the invention has a nucleotide sequence encoding a protein having an amino acid sequence shown in the Sequence Listing (e.g., an even-numbered SEQ ID NO:). In a still further embodiment, the nucleic acid molecule of the invention encodes a full length *C.*  
30 *glutamicum* protein which is substantially homologous to an amino acid sequence of the invention (encoded by an open reading frame shown in an odd-numbered SEQ ID NO: of the Sequence Listing).

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It will be understood by one of ordinary skill in the art that in one embodiment the sequences of the invention are not meant to include the sequences of the prior art, such as those Genbank sequences set forth in Tables 2 or 4 which were available prior to the present invention. In one embodiment, the invention includes nucleotide and amino acid sequences having a percent identity to a nucleotide or amino acid sequence of the invention which is greater than that of a sequence of the prior art (*e.g.*, a Genbank sequence (or the protein encoded by such a sequence) set forth in Tables 2 or 4). For example, the invention includes a nucleotide sequence which is greater than and/or at least 39% identical to the nucleotide sequence designated RXA00084 (SEQ ID NO:189), a nucleotide sequence which is greater than and/or at least 56% identical to the nucleotide sequence designated RXA00605 (SEQ ID NO:11), and a nucleotide sequence which is greater than and/or at least 50% identical to the nucleotide sequence designated RXA00886 (SEQ ID NO:39). One of ordinary skill in the art would be able to calculate the lower threshold of percent identity for any given sequence of the invention by examining the GAP-calculated percent identity scores set forth in Table 4 for each of the three top hits for the given sequence, and by subtracting the highest GAP-calculated percent identity from 100 percent. One of ordinary skill in the art will also appreciate that nucleic acid and amino acid sequences having percent identities greater than the lower threshold so calculated (*e.g.*, at least 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more identical) are also encompassed by the invention.

In addition to the *C. glutamicum* SRT nucleotide sequences set forth in the Sequence Listing as odd-numbered SEQ ID NOs, it will be appreciated by one of ordinary skill in the art that DNA sequence polymorphisms that lead to changes in the amino acid sequences of SRT proteins may exist within a population (*e.g.*, the *C. glutamicum* population). Such genetic polymorphism in the SRT gene may exist among individuals within a population due to natural variation. As used herein, the terms "gene" and "recombinant gene" refer to nucleic acid molecules comprising an open reading frame encoding an SRT protein, preferably a *C. glutamicum* SRT protein. Such

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natural variations can typically result in 1-5% variance in the nucleotide sequence of the SRT gene. Any and all such nucleotide variations and resulting amino acid polymorphisms in SRT that are the result of natural variation and that do not alter the functional activity of SRT proteins are intended to be within the scope of the invention.

5 Nucleic acid molecules corresponding to natural variants and non-*C. glutamicum* homologues of the *C. glutamicum* SRT DNA of the invention can be isolated based on their homology to the *C. glutamicum* SRT nucleic acid disclosed herein using the *C. glutamicum* DNA, or a portion thereof, as a hybridization probe according to standard hybridization techniques under stringent hybridization conditions. Accordingly, in  
10 another embodiment, an isolated nucleic acid molecule of the invention is at least 15 nucleotides in length and hybridizes under stringent conditions to the nucleic acid molecule comprising a nucleotide sequence of an odd-numbered SEQ ID NO: of the Sequence Listing. In other embodiments, the nucleic acid is at least 30, 50, 100, 250 or more nucleotides in length. As used herein, the term "hybridizes under stringent  
15 conditions" is intended to describe conditions for hybridization and washing under which nucleotide sequences at least 60% homologous to each other typically remain hybridized to each other. Preferably, the conditions are such that sequences at least about 65%, more preferably at least about 70%, and even more preferably at least about 75% or more homologous to each other typically remain hybridized to each other. Such  
20 stringent conditions are known to those of ordinary skill in the art in the art and can be found in Ausubel *et al.*, *Current Protocols in Molecular Biology*, John Wiley & Sons, N.Y. (1989), 6.3.1-6.3.6. A preferred, non-limiting example of stringent hybridization conditions are hybridization in 6X sodium chloride/sodium citrate (SSC) at about 45°C, followed by one or more washes in 0.2 X SSC, 0.1% SDS at 50-65°C. Preferably, an  
25 isolated nucleic acid molecule of the invention that hybridizes under stringent conditions to a nucleotide sequence of the invention corresponds to a naturally-occurring nucleic acid molecule. As used herein, a "naturally-occurring" nucleic acid molecule refers to an RNA or DNA molecule having a nucleotide sequence that occurs in nature (*e.g.*, encodes a natural protein). In one embodiment, the nucleic acid encodes a natural *C.*  
30 *glutamicum* SRT protein.

In addition to naturally-occurring variants of the SRT sequence that may exist in the population, one of ordinary skill in the art will further appreciate that changes can be

introduced by mutation into a nucleotide sequence of the invention, thereby leading to changes in the amino acid sequence of the encoded SRT protein, without altering the functional ability of the SRT protein. For example, nucleotide substitutions leading to amino acid substitutions at "non-essential" amino acid residues can be made in a  
5 nucleotide sequence of the invention. A "non-essential" amino acid residue is a residue that can be altered from the wild-type sequence of one of the SRT proteins (*e.g.*, an even-numbered SEQ ID NO: of the Sequence Listing) without altering the activity of said SRT protein, whereas an "essential" amino acid residue is required for SRT protein activity. Other amino acid residues, however, (*e.g.*, those that are not conserved or only  
10 semi-conserved in the domain having SRT activity) may not be essential for activity and thus are likely to be amenable to alteration without altering SRT activity.

Accordingly, another aspect of the invention pertains to nucleic acid molecules encoding SRT proteins that contain changes in amino acid residues that are not essential for SRT activity. Such SRT proteins differ in amino acid sequence from a sequence of  
15 an even-numbered SEQ ID NO: of the Sequence Listing yet retain at least one of the SRT activities described herein. In one embodiment, the isolated nucleic acid molecule comprises a nucleotide sequence encoding a protein, wherein the protein comprises an amino acid sequence at least about 50% homologous to an amino acid sequence of the invention and is capable of increasing the resistance or tolerance of *C. glutamicum* to  
20 one or more environmental or chemical stresses, or has one or more of the activities set forth in Table 1. Preferably, the protein encoded by the nucleic acid molecule is at least about 50-60% homologous to the amino acid sequence of one of the odd-numbered SEQ ID NOs of the Sequence Listing, more preferably at least about 60-70% homologous to one of these sequences, even more preferably at least about 70-80%, 80-90%, 90-95%  
25 homologous to one of these sequences in, and most preferably at least about 96%, 97%, 98%, or 99% homologous to one of the amino acid sequences of the invention.

To determine the percent homology of two amino acid sequences (*e.g.*, one of the amino acid sequences of the invention and a mutant form thereof) or of two nucleic acids, the sequences are aligned for optimal comparison purposes (*e.g.*, gaps can be  
30 introduced in the sequence of one protein or nucleic acid for optimal alignment with the other protein or nucleic acid). The amino acid residues or nucleotides at corresponding amino acid positions or nucleotide positions are then compared. When a position in one



sequence (*e.g.*, one of the amino acid sequences of the invention) is occupied by the same amino acid residue or nucleotide as the corresponding position in the other sequence (*e.g.*, a mutant form of the amino acid sequence), then the molecules are homologous at that position (*i.e.*, as used herein amino acid or nucleic acid "homology" is equivalent to amino acid or nucleic acid "identity"). The percent homology between the two sequences is a function of the number of identical positions shared by the sequences (*i.e.*, % homology = # of identical positions/total # of positions x 100).

An isolated nucleic acid molecule encoding an SRT protein homologous to a protein sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) can be created by introducing one or more nucleotide substitutions, additions or deletions into a nucleotide sequence of the invention such that one or more amino acid substitutions, additions or deletions are introduced into the encoded protein. Mutations can be introduced into one of the nucleotide sequences of the invention by standard techniques, such as site-directed mutagenesis and PCR-mediated mutagenesis. Preferably, conservative amino acid substitutions are made at one or more predicted non-essential amino acid residues. A "conservative amino acid substitution" is one in which the amino acid residue is replaced with an amino acid residue having a similar side chain. Families of amino acid residues having similar side chains have been defined in the art. These families include amino acids with basic side chains (*e.g.*, lysine, arginine, histidine), acidic side chains (*e.g.*, aspartic acid, glutamic acid), uncharged polar side chains (*e.g.*, glycine, asparagine, glutamine, serine, threonine, tyrosine, cysteine), nonpolar side chains (*e.g.*, alanine, valine, leucine, isoleucine, proline, phenylalanine, methionine, tryptophan), beta-branched side chains (*e.g.*, threonine, valine, isoleucine) and aromatic side chains (*e.g.*, tyrosine, phenylalanine, tryptophan, histidine). Thus, a predicted nonessential amino acid residue in an SRT protein is preferably replaced with another amino acid residue from the same side chain family. Alternatively, in another embodiment, mutations can be introduced randomly along all or part of an SRT coding sequence, such as by saturation mutagenesis, and the resultant mutants can be screened for an SRT activity described herein to identify mutants that retain SRT activity. Following mutagenesis of one the nucleotide sequence of one of the odd-numbered SEQ ID NOs of the Sequence Listing, the encoded protein can be expressed recombinantly and the activity of the protein can

be determined using, for example, assays described herein (see Example 8 of the Exemplification).

In addition to the nucleic acid molecules encoding SRT proteins described above, another aspect of the invention pertains to isolated nucleic acid molecules which are antisense thereto. An "antisense" nucleic acid comprises a nucleotide sequence which is complementary to a "sense" nucleic acid encoding a protein, *e.g.*, complementary to the coding strand of a double-stranded DNA molecule or complementary to an mRNA sequence. Accordingly, an antisense nucleic acid can hydrogen bond to a sense nucleic acid. The antisense nucleic acid can be complementary to an entire SRT coding strand, or to only a portion thereof. In one embodiment, an antisense nucleic acid molecule is antisense to a "coding region" of the coding strand of a nucleotide sequence encoding an SRT protein. The term "coding region" refers to the region of the nucleotide sequence comprising codons which are translated into amino acid residues (*e.g.*, the entire coding region of SEQ ID NO.: 120 (RXA00600) comprises nucleotides 1 to 1098). In another embodiment, the antisense nucleic acid molecule is antisense to a "noncoding region" of the coding strand of a nucleotide sequence encoding SRT. The term "noncoding region" refers to 5' and 3' sequences which flank the coding region that are not translated into amino acids (*i.e.*, also referred to as 5' and 3' untranslated regions).

Given the coding strand sequences encoding SRT disclosed herein (*e.g.*, the sequences set forth as odd-numbered SEQ ID NOs in the Sequence Listing), antisense nucleic acids of the invention can be designed according to the rules of Watson and Crick base pairing. The antisense nucleic acid molecule can be complementary to the entire coding region of SRT mRNA, but more preferably is an oligonucleotide which is antisense to only a portion of the coding or noncoding region of SRT mRNA. For example, the antisense oligonucleotide can be complementary to the region surrounding the translation start site of SRT mRNA. An antisense oligonucleotide can be, for example, about 5, 10, 15, 20, 25, 30, 35, 40, 45 or 50 nucleotides in length. An antisense nucleic acid of the invention can be constructed using chemical synthesis and enzymatic ligation reactions using procedures known in the art. For example, an antisense nucleic acid (*e.g.*, an antisense oligonucleotide) can be chemically synthesized using naturally occurring nucleotides or variously modified nucleotides designed to

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increase the biological stability of the molecules or to increase the physical stability of the duplex formed between the antisense and sense nucleic acids, *e.g.*, phosphorothioate derivatives and acridine substituted nucleotides can be used. Examples of modified nucleotides which can be used to generate the antisense nucleic acid include 5-  
5 fluorouracil, 5-bromouracil, 5-chlorouracil, 5-iodouracil, hypoxanthine, xanthine, 4-acetylcytosine, 5-(carboxyhydroxymethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine, 1-methylguanine, 1-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-  
10 methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil, beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methylthio-N6-isopentenyladenine, uracil-5-oxyacetic acid (v), wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 4-thiouracil, 5-methyluracil, uracil-5- oxyacetic acid  
15 methylester, uracil-5-oxyacetic acid (v), 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine. Alternatively, the antisense nucleic acid can be produced biologically using an expression vector into which a nucleic acid has been subcloned in an antisense orientation (*i.e.*, RNA transcribed from the inserted nucleic acid will be of an antisense orientation to a target nucleic acid of  
20 interest, described further in the following subsection).

The antisense nucleic acid molecules of the invention are typically administered to a cell or generated *in situ* such that they hybridize with or bind to cellular mRNA and/or genomic DNA encoding an SRT protein to thereby inhibit expression of the protein, *e.g.*, by inhibiting transcription and/or translation. The hybridization can be by  
25 conventional nucleotide complementarity to form a stable duplex, or, for example, in the case of an antisense nucleic acid molecule which binds to DNA duplexes, through specific interactions in the major groove of the double helix. The antisense molecule can be modified such that it specifically binds to a receptor or an antigen expressed on a selected cell surface, *e.g.*, by linking the antisense nucleic acid molecule to a peptide or  
30 an antibody which binds to a cell surface receptor or antigen. The antisense nucleic acid molecule can also be delivered to cells using the vectors described herein. To achieve sufficient intracellular concentrations of the antisense molecules, vector constructs in

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which the antisense nucleic acid molecule is placed under the control of a strong prokaryotic, viral, or eukaryotic promoter are preferred.

In yet another embodiment, the antisense nucleic acid molecule of the invention is an  $\alpha$ -anomeric nucleic acid molecule. An  $\alpha$ -anomeric nucleic acid molecule forms  
5 specific double-stranded hybrids with complementary RNA in which, contrary to the usual  $\beta$ -units, the strands run parallel to each other (Gaultier *et al.* (1987) *Nucleic Acids Res.* 15:6625-6641). The antisense nucleic acid molecule can also comprise a 2'-o-methylribonucleotide (Inoue *et al.* (1987) *Nucleic Acids Res.* 15:6131-6148) or a chimeric RNA-DNA analogue (Inoue *et al.* (1987) *FEBS Lett.* 215:327-330).

10 In still another embodiment, an antisense nucleic acid of the invention is a ribozyme. Ribozymes are catalytic RNA molecules with ribonuclease activity which are capable of cleaving a single-stranded nucleic acid, such as an mRNA, to which they have a complementary region. Thus, ribozymes (*e.g.*, hammerhead ribozymes (described in Haselhoff and Gerlach (1988) *Nature* 334:585-591)) can be used to  
15 catalytically cleave SRT mRNA transcripts to thereby inhibit translation of SRT mRNA. A ribozyme having specificity for an SRT-encoding nucleic acid can be designed based upon the nucleotide sequence of an SRT cDNA disclosed herein (*i.e.*, SEQ ID NO:119 (RXA00600)). For example, a derivative of a *Tetrahymena* L-19 IVS RNA can be constructed in which the nucleotide sequence of the active site is complementary to the  
20 nucleotide sequence to be cleaved in an SRT-encoding mRNA. See, *e.g.*, Cech *et al.* U.S. Patent No. 4,987,071 and Cech *et al.* U.S. Patent No. 5,116,742. Alternatively, SRT mRNA can be used to select a catalytic RNA having a specific ribonuclease activity from a pool of RNA molecules. See, *e.g.*, Bartel, D. and Szostak, J.W. (1993) *Science* 261:1411-1418.

25 Alternatively, SRT gene expression can be inhibited by targeting nucleotide sequences complementary to the regulatory region of an SRT nucleotide sequence (*e.g.*, an SRT promoter and/or enhancers) to form triple helical structures that prevent transcription of an SRT gene in target cells. See generally, Helene, C. (1991) *Anticancer Drug Des.* 6(6):569-84; Helene, C. *et al.* (1992) *Ann. N.Y. Acad. Sci.* 660:27-  
30 36; and Maher, L.J. (1992) *Bioassays* 14(12):807-15.

*B. Recombinant Expression Vectors and Host Cells*

Another aspect of the invention pertains to vectors, preferably expression vectors, containing a nucleic acid encoding an SRT protein (or a portion thereof). As used herein, the term "vector" refers to a nucleic acid molecule capable of transporting  
5 another nucleic acid to which it has been linked. One type of vector is a "plasmid", which refers to a circular double stranded DNA loop into which additional DNA segments can be ligated. Another type of vector is a viral vector, wherein additional DNA segments can be ligated into the viral genome. Certain vectors are capable of autonomous replication in a host cell into which they are introduced (*e.g.*, bacterial  
10 vectors having a bacterial origin of replication and episomal mammalian vectors). Other vectors (*e.g.*, non-episomal mammalian vectors) are integrated into the genome of a host cell upon introduction into the host cell, and thereby are replicated along with the host genome. Moreover, certain vectors are capable of directing the expression of genes to which they are operatively linked. Such vectors are referred to herein as "expression  
15 vectors". In general, expression vectors of utility in recombinant DNA techniques are often in the form of plasmids. In the present specification, "plasmid" and "vector" can be used interchangeably as the plasmid is the most commonly used form of vector. However, the invention is intended to include such other forms of expression vectors, such as viral vectors (*e.g.*, replication defective retroviruses, adenoviruses and adeno-  
20 associated viruses), which serve equivalent functions.

The recombinant expression vectors of the invention comprise a nucleic acid of the invention in a form suitable for expression of the nucleic acid in a host cell, which means that the recombinant expression vectors include one or more regulatory sequences, selected on the basis of the host cells to be used for expression, which is  
25 operatively linked to the nucleic acid sequence to be expressed. Within a recombinant expression vector, "operably linked" is intended to mean that the nucleotide sequence of interest is linked to the regulatory sequence(s) in a manner which allows for expression of the nucleotide sequence (*e.g.*, in an *in vitro* transcription/translation system or in a host cell when the vector is introduced into the host cell). The term "regulatory  
30 sequence" is intended to include promoters, enhancers and other expression control elements (*e.g.*, polyadenylation signals). Such regulatory sequences are described, for example, in Goeddel; *Gene Expression Technology: Methods in Enzymology* 185,



Academic Press, San Diego, CA (1990). Regulatory sequences include those which direct constitutive expression of a nucleotide sequence in many types of host cell and those which direct expression of the nucleotide sequence only in certain host cells. Preferred regulatory sequences are, for example, promoters such as cos-, tac-, trp-, tet-,  
5 trp-tet-, lpp-, lac-, lpp-lac-, lacI<sup>q</sup>-, T7-, T5-, T3-, gal-, trc-, ara-, SP6-, amy, SPO2,  $\lambda$ -P<sub>R</sub>- or  $\lambda$  P<sub>L</sub>, which are used preferably in bacteria. Additional regulatory sequences are, for example, promoters from yeasts and fungi, such as ADC1, MF $\alpha$ , AC, P-60, CYC1, GAPDH, TEF, rp28, ADH, promoters from plants such as CaMV/35S, SSU, OCS, lib4, usp, STLS1, B33, nos or ubiquitin- or phaseolin-promoters. It is also possible to use  
10 artificial promoters. It will be appreciated by one of ordinary skill in the art that the design of the expression vector can depend on such factors as the choice of the host cell to be transformed, the level of expression of protein desired, etc. The expression vectors of the invention can be introduced into host cells to thereby produce proteins or peptides, including fusion proteins or peptides, encoded by nucleic acids as described  
15 herein (e.g., SRT proteins, mutant forms of SRT proteins, fusion proteins, etc.).

The recombinant expression vectors of the invention can be designed for expression of SRT proteins in prokaryotic or eukaryotic cells. For example, SRT genes can be expressed in bacterial cells such as *C. glutamicum*, insect cells (using baculovirus expression vectors), yeast and other fungal cells (see Romanos, M.A. *et al.* (1992)  
20 "Foreign gene expression in yeast: a review", *Yeast* 8: 423-488; van den Hondel, C.A.M.J.J. *et al.* (1991) "Heterologous gene expression in filamentous fungi" in: More Gene Manipulations in Fungi, J.W. Bennet & L.L. Lasure, eds., p. 396-428: Academic Press: San Diego; and van den Hondel, C.A.M.J.J. & Punt, P.J. (1991) "Gene transfer systems and vector development for filamentous fungi, in: Applied Molecular Genetics  
25 of Fungi, Peberdy, J.F. *et al.*, eds., p. 1-28, Cambridge University Press: Cambridge), algae and multicellular plant cells (see Schmidt, R. and Willmitzer, L. (1988) High efficiency *Agrobacterium tumefaciens* -mediated transformation of *Arabidopsis thaliana* leaf and cotyledon explants" *Plant Cell Rep.*: 583-586), or mammalian cells. Suitable host cells are discussed further in Goeddel, *Gene Expression Technology*:  
30 *Methods in Enzymology* 185, Academic Press, San Diego, CA (1990). Alternatively, the recombinant expression vector can be transcribed and translated *in vitro*, for example using T7 promoter regulatory sequences and T7 polymerase.

Expression of proteins in prokaryotes is most often carried out with vectors containing constitutive or inducible promoters directing the expression of either fusion or non-fusion proteins. Fusion vectors add a number of amino acids to a protein encoded therein, usually to the amino terminus of the recombinant protein. Such fusion  
5 vectors typically serve three purposes: 1) to increase expression of recombinant protein; 2) to increase the solubility of the recombinant protein; and 3) to aid in the purification of the recombinant protein by acting as a ligand in affinity purification. Often, in fusion expression vectors, a proteolytic cleavage site is introduced at the junction of the fusion moiety and the recombinant protein to enable separation of the recombinant protein  
10 from the fusion moiety subsequent to purification of the fusion protein. Such enzymes, and their cognate recognition sequences, include Factor Xa, thrombin and enterokinase.

Typical fusion expression vectors include pGEX (Pharmacia Biotech Inc; Smith, D.B. and Johnson, K.S. (1988) *Gene* 67:31-40), pMAL (New England Biolabs, Beverly, MA) and pRIT5 (Pharmacia, Piscataway, NJ) which fuse glutathione S-transferase  
15 (GST), maltose E binding protein, or protein A, respectively, to the target recombinant protein. In one embodiment, the coding sequence of the SRT protein is cloned into a pGEX expression vector to create a vector encoding a fusion protein comprising, from the N-terminus to the C-terminus, GST-thrombin cleavage site-X protein. The fusion protein can be purified by affinity chromatography using glutathione-agarose resin.  
20 Recombinant SRT protein unfused to GST can be recovered by cleavage of the fusion protein with thrombin.

Examples of suitable inducible non-fusion *E. coli* expression vectors include pTrc (Amann *et al.*, (1988) *Gene* 69:301-315) pLG338, pACYC184, pBR322, pUC18, pUC19, pKC30, pRep4, pHS1, pHS2, pPLc236, pMBL24, pLG200, pUR290, pIN-  
25 III113-B1,  $\lambda$ gt11, pBdCl, and pET 11d (Studier *et al.*, *Gene Expression Technology: Methods in Enzymology* 185, Academic Press, San Diego, California (1990) 60-89; and Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York ISBN 0 444 904018). Target gene expression from the pTrc vector relies on host RNA polymerase transcription from a hybrid trp-lac fusion promoter. Target gene expression from the  
30 pET 11d vector relies on transcription from a T7 gn10-lac fusion promoter mediated by a coexpressed viral RNA polymerase (T7 gn1). This viral polymerase is supplied by host strains BL21(DE3) or HMS174(DE3) from a resident  $\lambda$  prophage harboring a T7

gnl gene under the transcriptional control of the lacUV 5 promoter. For transformation of other varieties of bacteria, appropriate vectors may be selected. For example, the plasmids pIJ101, pIJ364, pIJ702 and pIJ361 are known to be useful in transforming *Streptomyces*, while plasmids pUB110, pC194, or pBD214 are suited for transformation of *Bacillus* species. Several plasmids of use in the transfer of genetic information into *Corynebacterium* include pHM1519, pBL1, pSA77, or pAJ667 (Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York ISBN 0 444 904018).

One strategy to maximize recombinant protein expression is to express the protein in a host bacteria with an impaired capacity to proteolytically cleave the recombinant protein (Gottesman, S., *Gene Expression Technology: Methods in Enzymology* 185, Academic Press, San Diego, California (1990) 119-128). Another strategy is to alter the nucleic acid sequence of the nucleic acid to be inserted into an expression vector so that the individual codons for each amino acid are those preferentially utilized in the bacterium chosen for expression, such as *C. glutamicum* (Wada *et al.* (1992) *Nucleic Acids Res.* 20:2111-2118). Such alteration of nucleic acid sequences of the invention can be carried out by standard DNA synthesis techniques.

In another embodiment, the SRT protein expression vector is a yeast expression vector. Examples of vectors for expression in yeast *S. cerevisiae* include pYepSec1 (Baldari, *et al.*, (1987) *Embo J.* 6:229-234), 2  $\mu$ , pAG-1, Yep6, Yep13, pEMBLYe23, pMFa (Kurjan and Herskowitz, (1982) *Cell* 30:933-943), pJRY88 (Schultz *et al.*, (1987) *Gene* 54:113-123), and pYES2 (Invitrogen Corporation, San Diego, CA). Vectors and methods for the construction of vectors appropriate for use in other fungi, such as the filamentous fungi, include those detailed in: van den Hondel, C.A.M.J.J. & Punt, P.J. (1991) "Gene transfer systems and vector development for filamentous fungi, in: Applied Molecular Genetics of Fungi, J.F. Peberdy, *et al.*, eds., p. 1-28, Cambridge University Press: Cambridge, and Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York (ISBN 0 444 904018).

Alternatively, the SRT proteins of the invention can be expressed in insect cells using baculovirus expression vectors. Baculovirus vectors available for expression of proteins in cultured insect cells (*e.g.*, Sf 9 cells) include the pAc series (Smith *et al.* (1983) *Mol. Cell Biol.* 3:2156-2165) and the pVL series (Lucklow and Summers (1989) *Virology* 170:31-39).

In another embodiment, the SRT proteins of the invention may be expressed in unicellular plant cells (such as algae) or in plant cells from higher plants (e.g., the spermatophytes, such as crop plants). Examples of plant expression vectors include those detailed in: Becker, D., Kemper, E., Schell, J. and Masterson, R. (1992) "New  
5 plant binary vectors with selectable markers located proximal to the left border", *Plant Mol. Biol.* 20: 1195-1197; and Bevan, M.W. (1984) "Binary *Agrobacterium* vectors for plant transformation", *Nucl. Acid. Res.* 12: 8711-8721, and include pLGV23, pGHlac+, pBIN19, pAK2004, and pDH51 (Pouwels *et al.*, eds. (1985) *Cloning Vectors*. Elsevier: New York ISBN 0 444 904018).

10 In yet another embodiment, a nucleic acid of the invention is expressed in mammalian cells using a mammalian expression vector. Examples of mammalian expression vectors include pCDM8 (Seed, B. (1987) *Nature* 329:840) and pMT2PC (Kaufman *et al.* (1987) *EMBO J.* 6:187-195). When used in mammalian cells, the expression vector's control functions are often provided by viral regulatory elements.  
15 For example, commonly used promoters are derived from polyoma, Adenovirus 2, cytomegalovirus and Simian Virus 40. For other suitable expression systems for both prokaryotic and eukaryotic cells see chapters 16 and 17 of Sambrook, J., Fritsh, E. F., and Maniatis, T. *Molecular Cloning: A Laboratory Manual. 2nd, ed.*, Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY,  
20 1989.

In another embodiment, the recombinant mammalian expression vector is capable of directing expression of the nucleic acid preferentially in a particular cell type (e.g., tissue-specific regulatory elements are used to express the nucleic acid). Tissue-specific regulatory elements are known in the art. Non-limiting examples of suitable  
25 tissue-specific promoters include the albumin promoter (liver-specific; Pinkert *et al.* (1987) *Genes Dev.* 1:268-277), lymphoid-specific promoters (Calame and Eaton (1988) *Adv. Immunol.* 43:235-275), in particular promoters of T cell receptors (Winoto and Baltimore (1989) *EMBO J.* 8:729-733) and immunoglobulins (Banerji *et al.* (1983) *Cell* 33:729-740; Queen and Baltimore (1983) *Cell* 33:741-748), neuron-specific promoters  
30 (e.g., the neurofilament promoter; Byrne and Ruddle (1989) *PNAS* 86:5473-5477), pancreas-specific promoters (Edlund *et al.* (1985) *Science* 230:912-916), and mammary gland-specific promoters (e.g., milk whey promoter; U.S. Patent No. 4,873,316 and

European Application Publication No. 264,166). Developmentally-regulated promoters are also encompassed, for example the murine hox promoters (Kessel and Gruss (1990) *Science* 249:374-379) and the  $\alpha$ -fetoprotein promoter (Campes and Tilghman (1989) *Genes Dev.* 3:537-546).

5           The invention further provides a recombinant expression vector comprising a DNA molecule of the invention cloned into the expression vector in an antisense orientation. That is, the DNA molecule is operatively linked to a regulatory sequence in a manner which allows for expression (by transcription of the DNA molecule) of an RNA molecule which is antisense to SRT mRNA. Regulatory sequences operatively  
10   linked to a nucleic acid cloned in the antisense orientation can be chosen which direct the continuous expression of the antisense RNA molecule in a variety of cell types, for instance viral promoters and/or enhancers, or regulatory sequences can be chosen which direct constitutive, tissue specific or cell type specific expression of antisense RNA. The antisense expression vector can be in the form of a recombinant plasmid, phagemid  
15   or attenuated virus in which antisense nucleic acids are produced under the control of a high efficiency regulatory region, the activity of which can be determined by the cell type into which the vector is introduced. For a discussion of the regulation of gene expression using antisense genes see Weintraub, H. *et al.*, Antisense RNA as a molecular tool for genetic analysis, *Reviews - Trends in Genetics*, Vol. 1(1) 1986.

20           Another aspect of the invention pertains to host cells into which a recombinant expression vector of the invention has been introduced. The terms "host cell" and "recombinant host cell" are used interchangeably herein. It is understood that such terms refer not only to the particular subject cell but to the progeny or potential progeny of such a cell. Because certain modifications may occur in succeeding generations due  
25   to either mutation or environmental influences, such progeny may not, in fact, be identical to the parent cell, but are still included within the scope of the term as used herein.

          A host cell can be any prokaryotic or eukaryotic cell. For example, an SRT protein can be expressed in bacterial cells such as *C. glutamicum*, insect cells, yeast or  
30   mammalian cells (such as Chinese hamster ovary cells (CHO) or COS cells). Other suitable host cells are known to those of ordinary skill in the art. Microorganisms related



to *Corynebacterium glutamicum* which may be conveniently used as host cells for the nucleic acid and protein molecules of the invention are set forth in Table 3.

Vector DNA can be introduced into prokaryotic or eukaryotic cells via conventional transformation or transfection techniques. As used herein, the terms

5 "transformation" and "transfection" are intended to refer to a variety of art-recognized techniques for introducing foreign nucleic acid (*e.g.*, linear DNA or RNA (*e.g.*, a linearized vector or a gene construct alone without a vector) or nucleic acid in the form of a vector (*e.g.*, a plasmid, phage, phasmid, phagemid, transposon or other DNA)) into a host cell, including calcium phosphate or calcium chloride co-precipitation, DEAE-

10 dextran-mediated transfection, lipofection, or electroporation. Suitable methods for transforming or transfecting host cells can be found in Sambrook, *et al.* (*Molecular Cloning: A Laboratory Manual. 2nd, ed., Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989*), and other laboratory manuals.

For stable transfection of mammalian cells, it is known that, depending upon the

15 expression vector and transfection technique used, only a small fraction of cells may integrate the foreign DNA into their genome. In order to identify and select these integrants, a gene that encodes a selectable marker (*e.g.*, resistance to antibiotics) is generally introduced into the host cells along with the gene of interest. Preferred selectable markers include those which confer resistance to drugs, such as G418,

20 hygromycin and methotrexate. Nucleic acid encoding a selectable marker can be introduced into a host cell on the same vector as that encoding an SRT protein or can be introduced on a separate vector. Cells stably transfected with the introduced nucleic acid can be identified by drug selection (*e.g.*, cells that have incorporated the selectable marker gene will survive, while the other cells die).

25 To create a homologous recombinant microorganism, a vector is prepared which contains at least a portion of an SRT gene into which a deletion, addition or substitution has been introduced to thereby alter, *e.g.*, functionally disrupt, the SRT gene.

Preferably, this SRT gene is a *Corynebacterium glutamicum* SRT gene, but it can be a homologue from a related bacterium or even from a mammalian, yeast, or insect source.

30 In a preferred embodiment, the vector is designed such that, upon homologous recombination, the endogenous SRT gene is functionally disrupted (*i.e.*, no longer encodes a functional protein; also referred to as a "knock out" vector). Alternatively,

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the vector can be designed such that, upon homologous recombination, the endogenous SRT gene is mutated or otherwise altered but still encodes functional protein (*e.g.*, the upstream regulatory region can be altered to thereby alter the expression of the endogenous SRT protein). In the homologous recombination vector, the altered portion of the SRT gene is flanked at its 5' and 3' ends by additional nucleic acid of the SRT gene to allow for homologous recombination to occur between the exogenous SRT gene carried by the vector and an endogenous SRT gene in a microorganism. The additional flanking SRT nucleic acid is of sufficient length for successful homologous recombination with the endogenous gene. Typically, several kilobases of flanking DNA (both at the 5' and 3' ends) are included in the vector (see *e.g.*, Thomas, K.R., and Capecchi, M.R. (1987) Cell 51: 503 for a description of homologous recombination vectors). The vector is introduced into a microorganism (*e.g.*, by electroporation) and cells in which the introduced SRT gene has homologously recombined with the endogenous SRT gene are selected, using art-known techniques.

15 In another embodiment, recombinant microorganisms can be produced which contain selected systems which allow for regulated expression of the introduced gene. For example, inclusion of an SRT gene on a vector placing it under control of the lac operon permits expression of the SRT gene only in the presence of IPTG. Such regulatory systems are well known in the art.

20 In another embodiment, an endogenous SRT gene in a host cell is disrupted (*e.g.*, by homologous recombination or other genetic means known in the art) such that expression of its protein product does not occur. In another embodiment, an endogenous or introduced SRT gene in a host cell has been altered by one or more point mutations, deletions, or inversions, but still encodes a functional SRT protein. In still another embodiment, one or more of the regulatory regions (*e.g.*, a promoter, repressor, or inducer) of an SRT gene in a microorganism has been altered (*e.g.*, by deletion, truncation, inversion, or point mutation) such that the expression of the SRT gene is modulated. One of ordinary skill in the art will appreciate that host cells containing more than one of the described SRT gene and protein modifications may be readily produced using the methods of the invention, and are meant to be included in the present invention.

A host cell of the invention, such as a prokaryotic or eukaryotic host cell in culture, can be used to produce (*i.e.*, express) an SRT protein. Accordingly, the invention further provides methods for producing SRT proteins using the host cells of the invention. In one embodiment, the method comprises culturing the host cell of invention (into which a recombinant expression vector encoding an SRT protein has  
5 been introduced, or into which genome has been introduced a gene encoding a wild-type or altered SRT protein) in a suitable medium until SRT protein is produced. In another embodiment, the method further comprises isolating SRT proteins from the medium or the host cell.

10

### *C. Isolated SRT Proteins*

Another aspect of the invention pertains to isolated SRT proteins, and biologically active portions thereof. An "isolated" or "purified" protein or biologically active portion thereof is substantially free of cellular material when produced by  
15 recombinant DNA techniques, or chemical precursors or other chemicals when chemically synthesized. The language "substantially free of cellular material" includes preparations of SRT protein in which the protein is separated from cellular components of the cells in which it is naturally or recombinantly produced. In one embodiment, the language "substantially free of cellular material" includes preparations of SRT protein  
20 having less than about 30% (by dry weight) of non-SRT protein (also referred to herein as a "contaminating protein"), more preferably less than about 20% of non-SRT protein, still more preferably less than about 10% of non-SRT protein, and most preferably less than about 5% non-SRT protein. When the SRT protein or biologically active portion thereof is recombinantly produced, it is also preferably substantially free of culture  
25 medium, *i.e.*, culture medium represents less than about 20%, more preferably less than about 10%, and most preferably less than about 5% of the volume of the protein preparation. The language "substantially free of chemical precursors or other chemicals" includes preparations of SRT protein in which the protein is separated from chemical precursors or other chemicals which are involved in the synthesis of the  
30 protein. In one embodiment, the language "substantially free of chemical precursors or other chemicals" includes preparations of SRT protein having less than about 30% (by dry weight) of chemical precursors or non-SRT chemicals, more preferably less than

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about 20% chemical precursors or non-SRT chemicals, still more preferably less than about 10% chemical precursors or non-SRT chemicals, and most preferably less than about 5% chemical precursors or non-SRT chemicals. In preferred embodiments, isolated proteins or biologically active portions thereof lack contaminating proteins from the same organism from which the SRT protein is derived. Typically, such proteins are produced by recombinant expression of, for example, a *C. glutamicum* SRT protein in a microorganism such as *C. glutamicum*.

An isolated SRT protein or a portion thereof of the invention can contribute to the resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses or hazards, or has one or more of the activities set forth in Table 1. In preferred embodiments, the protein or portion thereof comprises an amino acid sequence which is sufficiently homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of the Sequence Listing) such that the protein or portion thereof maintains the ability to mediate the resistance or tolerance of *C. glutamicum* to one or more chemical or environmental stresses or hazards. The portion of the protein is preferably a biologically active portion as described herein. In another preferred embodiment, an SRT protein of the invention has an amino acid sequence set forth as an even-numbered SEQ ID NO: of the Sequence Listing. In yet another preferred embodiment, the SRT protein has an amino acid sequence which is encoded by a nucleotide sequence which hybridizes, *e.g.*, hybridizes under stringent conditions, to a nucleotide sequence of the invention (*e.g.*, a sequence of an odd-numbered SEQ ID NO: of the Sequence Listing). In still another preferred embodiment, the SRT protein has an amino acid sequence which is encoded by a nucleotide sequence that is at least about 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to one of the nucleic acid sequences of the invention, or a portion thereof. Ranges and identity values intermediate to the above-recited values, (*e.g.*, 70-90% identical or 80-95% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper

and/or lower limits are intended to be included. The preferred SRT proteins of the present invention also preferably possess at least one of the SRT activities described herein. For example, a preferred SRT protein of the present invention includes an amino acid sequence encoded by a nucleotide sequence which hybridizes, *e.g.*, hybridizes  
5 under stringent conditions, to a nucleotide sequence of the invention, and which can increase the resistance or tolerance of *C. glutamicum* to one or more environmental or chemical stresses, or which has one or more of the activities set forth in Table 1.

In other embodiments, the SRT protein is substantially homologous to an amino acid sequence of the invention (*e.g.*, a sequence of an even-numbered SEQ ID NO: of  
10 the Sequence Listing) and retains the functional activity of the protein of one of the amino acid sequences of the invention yet differs in amino acid sequence due to natural variation or mutagenesis, as described in detail in subsection I above. Accordingly, in another embodiment, the SRT protein is a protein which comprises an amino acid sequence which is at least about 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%,  
15 59%, or 60%, preferably at least about 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, or 70%, more preferably at least about 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, or 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, or 90%, or 91%, 92%, 93%, 94%, and even more preferably at least about 95%, 96%, 97%, 98%, 99% or more homologous to an entire amino acid sequence of the invention and which  
20 has at least one of the SRT activities described herein. Ranges and identity values intermediate to the above-recited values, (*e.g.*, 70-90% identical or 80-95% identical) are also intended to be encompassed by the present invention. For example, ranges of identity values using a combination of any of the above values recited as upper and/or lower limits are intended to be included. In another embodiment, the invention pertains  
25 to a full length *C. glutamicum* protein which is substantially homologous to an entire amino acid sequence of the invention.

Biologically active portions of an SRT protein include peptides comprising amino acid sequences derived from the amino acid sequence of an SRT protein, *e.g.*, an amino acid sequence of an even-numbered SEQ ID NO: of the Sequence Listing or the  
30 amino acid sequence of a protein homologous to an SRT protein, which include fewer amino acids than a full length SRT protein or the full length protein which is homologous to an SRT protein, and exhibit at least one activity of an SRT protein.



Typically, biologically active portions (peptides, *e.g.*, peptides which are, for example, 5, 10, 15, 20, 30, 35, 36, 37, 38, 39, 40, 50, 100 or more amino acids in length) comprise a domain or motif with at least one activity of an SRT protein. Moreover, other biologically active portions, in which other regions of the protein are deleted, can be prepared by recombinant techniques and evaluated for one or more of the activities described herein. Preferably, the biologically active portions of an SRT protein include one or more selected domains/motifs or portions thereof having biological activity.

SRT proteins are preferably produced by recombinant DNA techniques. For example, a nucleic acid molecule encoding the protein is cloned into an expression vector (as described above), the expression vector is introduced into a host cell (as described above) and the SRT protein is expressed in the host cell. The SRT protein can then be isolated from the cells by an appropriate purification scheme using standard protein purification techniques. Alternative to recombinant expression, an SRT protein, polypeptide, or peptide can be synthesized chemically using standard peptide synthesis techniques. Moreover, native SRT protein can be isolated from cells (*e.g.*, endothelial cells), for example using an anti-SRT antibody, which can be produced by standard techniques utilizing an SRT protein or fragment thereof of this invention.

The invention also provides SRT chimeric or fusion proteins. As used herein, an SRT "chimeric protein" or "fusion protein" comprises an SRT polypeptide operatively linked to a non-SRT polypeptide. An "SRT polypeptide" refers to a polypeptide having an amino acid sequence corresponding to SRT, whereas a "non-SRT polypeptide" refers to a polypeptide having an amino acid sequence corresponding to a protein which is not substantially homologous to the SRT protein, *e.g.*, a protein which is different from the SRT protein and which is derived from the same or a different organism. Within the fusion protein, the term "operatively linked" is intended to indicate that the SRT polypeptide and the non-SRT polypeptide are fused in-frame to each other. The non-SRT polypeptide can be fused to the N-terminus or C-terminus of the SRT polypeptide. For example, in one embodiment the fusion protein is a GST-SRT fusion protein in which the SRT sequences are fused to the C-terminus of the GST sequences. Such fusion proteins can facilitate the purification of recombinant SRT proteins. In another embodiment, the fusion protein is an SRT protein containing a heterologous signal sequence at its N-terminus. In certain host cells (*e.g.*, mammalian host cells), expression

and/or secretion of an SRT protein can be increased through use of a heterologous signal sequence.

Preferably, an SRT chimeric or fusion protein of the invention is produced by standard recombinant DNA techniques. For example, DNA fragments coding for the  
5 different polypeptide sequences are ligated together in-frame in accordance with conventional techniques, for example by employing blunt-ended or stagger-ended termini for ligation, restriction enzyme digestion to provide for appropriate termini, filling-in of cohesive ends as appropriate, alkaline phosphatase treatment to avoid undesirable joining, and enzymatic ligation. In another embodiment, the fusion gene  
10 can be synthesized by conventional techniques including automated DNA synthesizers. Alternatively, PCR amplification of gene fragments can be carried out using anchor primers which give rise to complementary overhangs between two consecutive gene fragments which can subsequently be annealed and reamplified to generate a chimeric gene sequence (see, for example, *Current Protocols in Molecular Biology*, eds. Ausubel  
15 *et al.* John Wiley & Sons: 1992). Moreover, many expression vectors are commercially available that already encode a fusion moiety (*e.g.*, a GST polypeptide). An SRT-encoding nucleic acid can be cloned into such an expression vector such that the fusion moiety is linked in-frame to the SRT protein.

Homologues of the SRT protein can be generated by mutagenesis, *e.g.*, discrete  
20 point mutation or truncation of the SRT protein. As used herein, the term "homologue" refers to a variant form of the SRT protein which acts as an agonist or antagonist of the activity of the SRT protein. An agonist of the SRT protein can retain substantially the same, or a subset, of the biological activities of the SRT protein. An antagonist of the SRT protein can inhibit one or more of the activities of the naturally occurring form of  
25 the SRT protein, by, for example, competitively binding to a downstream or upstream member of the SRT system which includes the SRT protein. Thus, the *C. glutamicum* SRT protein and homologues thereof of the present invention may increase the tolerance or resistance of *C. glutamicum* to one or more chemical or environmental stresses.

In an alternative embodiment, homologues of the SRT protein can be identified  
30 by screening combinatorial libraries of mutants, *e.g.*, truncation mutants, of the SRT protein for SRT protein agonist or antagonist activity. In one embodiment, a variegated library of SRT variants is generated by combinatorial mutagenesis at the nucleic acid

level and is encoded by a variegated gene library. A variegated library of SRT variants can be produced by, for example, enzymatically ligating a mixture of synthetic oligonucleotides into gene sequences such that a degenerate set of potential SRT sequences is expressible as individual polypeptides, or alternatively, as a set of larger fusion proteins (*e.g.*, for phage display) containing the set of SRT sequences therein. There are a variety of methods which can be used to produce libraries of potential SRT homologues from a degenerate oligonucleotide sequence. Chemical synthesis of a degenerate gene sequence can be performed in an automatic DNA synthesizer, and the synthetic gene then ligated into an appropriate expression vector. Use of a degenerate set of genes allows for the provision, in one mixture, of all of the sequences encoding the desired set of potential SRT sequences. Methods for synthesizing degenerate oligonucleotides are known in the art (see, *e.g.*, Narang, S.A. (1983) *Tetrahedron* 39:3; Itakura *et al.* (1984) *Annu. Rev. Biochem.* 53:323; Itakura *et al.* (1984) *Science* 198:1056; Ike *et al.* (1983) *Nucleic Acid Res.* 11:477.

15 In addition, libraries of fragments of the SRT protein coding can be used to generate a variegated population of SRT fragments for screening and subsequent selection of homologues of an SRT protein. In one embodiment, a library of coding sequence fragments can be generated by treating a double stranded PCR fragment of an SRT coding sequence with a nuclease under conditions wherein nicking occurs only about once per molecule, denaturing the double stranded DNA, renaturing the DNA to form double stranded DNA which can include sense/antisense pairs from different nicked products, removing single stranded portions from reformed duplexes by treatment with S1 nuclease, and ligating the resulting fragment library into an expression vector. By this method, an expression library can be derived which encodes N-terminal, 20 C-terminal and internal fragments of various sizes of the SRT protein.

Several techniques are known in the art for screening gene products of combinatorial libraries made by point mutations or truncation, and for screening cDNA libraries for gene products having a selected property. Such techniques are adaptable for rapid screening of the gene libraries generated by the combinatorial mutagenesis of SRT homologues. The most widely used techniques, which are amenable to high through-put analysis, for screening large gene libraries typically include cloning the gene library into replicable expression vectors, transforming appropriate cells with the resulting library of 30

vectors, and expressing the combinatorial genes under conditions in which detection of a desired activity facilitates isolation of the vector encoding the gene whose product was detected. Recursive ensemble mutagenesis (REM), a new technique which enhances the frequency of functional mutants in the libraries, can be used in combination with the  
5 screening assays to identify SRT homologues (Arkin and Yourvan (1992) *PNAS* 89:7811-7815; Delgrave *et al.* (1993) *Protein Engineering* 6(3):327-331).

In another embodiment, cell based assays can be exploited to analyze a variegated SRT library, using methods well known in the art.

#### 10 D. Uses and Methods of the Invention

The nucleic acid molecules, proteins, protein homologues, fusion proteins, primers, vectors, and host cells described herein can be used in one or more of the following methods: identification of *C. glutamicum* and related organisms; mapping of genomes of organisms related to *C. glutamicum*; identification and localization of *C.*  
15 *glutamicum* sequences of interest; evolutionary studies; determination of SRT protein regions required for function; modulation of an SRT protein activity; modulation of the activity of an SRT pathway; and modulation of cellular production of a desired compound, such as a fine chemical.

The SRT nucleic acid molecules of the invention have a variety of uses. First,  
20 they may be used to identify an organism as being *Corynebacterium glutamicum* or a close relative thereof. Also, they may be used to identify the presence of *C. glutamicum* or a relative thereof in a mixed population of microorganisms. The invention provides the nucleic acid sequences of a number of *C. glutamicum* genes; by probing the extracted genomic DNA of a culture of a unique or mixed population of microorganisms  
25 under stringent conditions with a probe spanning a region of a *C. glutamicum* gene which is unique to this organism, one can ascertain whether this organism is present.

Although *Corynebacterium glutamicum* itself is nonpathogenic, it is related to pathogenic species, such as *Corynebacterium diphtheriae*. *Corynebacterium diphtheriae* is the causative agent of diphtheria, a rapidly developing, acute, febrile infection which  
30 involves both local and systemic pathology. In this disease, a local lesion develops in the upper respiratory tract and involves necrotic injury to epithelial cells; the bacilli secrete toxin which is disseminated through this lesion to distal susceptible tissues of the

body. Degenerative changes brought about by the inhibition of protein synthesis in these tissues, which include heart, muscle, peripheral nerves, adrenals, kidneys, liver and spleen, result in the systemic pathology of the disease. Diphtheria continues to have high incidence in many parts of the world, including Africa, Asia, Eastern Europe and the independent states of the former Soviet Union. An ongoing epidemic of diphtheria in the latter two regions has resulted in at least 5,000 deaths since 1990.

In one embodiment, the invention provides a method of identifying the presence or activity of *Corynebacterium diphtheriae* in a subject. This method includes detection of one or more of the nucleic acid or amino acid sequences of the invention (e.g., the sequences set forth as odd-numbered or even-numbered SEQ ID NOs, respectively, in the Sequence Listing) in a subject, thereby detecting the presence or activity of *Corynebacterium diphtheriae* in the subject. *C. glutamicum* and *C. diphtheriae* are related bacteria, and many of the nucleic acid and protein molecules in *C. glutamicum* are homologous to *C. diphtheriae* nucleic acid and protein molecules, and can therefore be used to detect *C. diphtheriae* in a subject.

The nucleic acid and protein molecules of the invention may also serve as markers for specific regions of the genome. This has utility not only in the mapping of the genome, but also for functional studies of *C. glutamicum* proteins. For example, to identify the region of the genome to which a particular *C. glutamicum* DNA-binding protein binds, the *C. glutamicum* genome could be digested, and the fragments incubated with the DNA-binding protein. Those which bind the protein may be additionally probed with the nucleic acid molecules of the invention, preferably with readily detectable labels; binding of such a nucleic acid molecule to the genome fragment enables the localization of the fragment to the genome map of *C. glutamicum*, and, when performed multiple times with different enzymes, facilitates a rapid determination of the nucleic acid sequence to which the protein binds. Further, the nucleic acid molecules of the invention may be sufficiently homologous to the sequences of related species such that these nucleic acid molecules may serve as markers for the construction of a genomic map in related bacteria, such as *Brevibacterium lactofermentum*.

The SRT nucleic acid molecules of the invention are also useful for evolutionary and protein structural studies. The resistance processes in which the molecules of the invention participate are utilized by a wide variety of cells; by comparing the sequences



of the nucleic acid molecules of the present invention to those encoding similar enzymes from other organisms, the evolutionary relatedness of the organisms can be assessed. Similarly, such a comparison permits an assessment of which regions of the sequence are conserved and which are not, which may aid in determining those regions of the protein which are essential for the functioning of the enzyme. This type of determination is of value for protein engineering studies and may give an indication of what the protein can tolerate in terms of mutagenesis without losing function.

The genes of the invention, *e.g.*, the gene encoding LMRB (SEQ ID NO:1) or other gene of the invention encoding a chemical or environmental resistance or tolerance protein (*e.g.*, resistance against one or more antibiotics), may be used as genetic markers for the genetic transformation of (*e.g.*, the transfer of additional genes into or disruption of preexisting genes of) organisms such as *C. glutamicum* or other bacterial species. Use of these nucleic acid molecules permits efficient selection of organisms which have incorporated a given transgene cassette (*e.g.*, a plasmid, phage, phasmid, phagemid, transposon, or other nucleic acid element), based on a trait which permits the survival of the organism in an otherwise hostile or toxic environment (*e.g.*, in the presence of an antimicrobial compound). By employing one or more of the genes of the invention as genetic markers, the speed and ease with which organisms having desirable transformed traits (*e.g.*, modulated fine chemical production) are engineered and isolated are improved. While it is advantageous to use the genes of the invention for selection of transformed *C. glutamicum* and related bacteria, it is possible, as described herein, to use homologs (*e.g.*, homologs from other organisms), allelic variants or fragments of the gene retaining desired activity. Furthermore, 5' and 3' regulatory elements of the genes of the invention may be modified as described herein (*e.g.*, by nucleotide substitution, insertion, deletion, or replacement with a more desirable genetic element) to modulate the transcription of the gene. For example, an LMRB variant in which the nucleotide sequence in the region from -1 to -200 5' to the start codon has been altered to modulate (preferably increase) the transcription and/or translation of LMRB may be employed, as can constructs in which a gene of the invention (*e.g.*, the LMRB gene (SEQ ID NO:1)) is functionally coupled to one or more regulatory signals (*e.g.*, inducer or repressor binding sequences) which can be used for modulating gene expression.

Similarly, more than one copy of a gene (functional or inactivated) of the invention may be employed.

An additional application of the genes of the invention (*e.g.*, the gene encoding LMRB (SEQ ID NO:1) or other drug- or antibiotic-resistance gene) is in the discovery  
5 of new antibiotics which are active against *Corynebacteria* and/or other bacteria. For example, a gene of the invention may be expressed (or overexpressed) in a suitable host to generate an organism with increased resistance to one or more drugs or antibiotics (in the case of LMRB, lincosamides in particular, especially lincomycin). This type of resistant host can subsequently be used to screen for chemicals with bacteriostatic and/or  
10 bacteriocidal activity, such as novel antibiotic compounds. It is possible, in particular, to use the genes of the invention (*e.g.*, the LMRB gene) to identify new antibiotics which are active against those microorganisms which are already resistant to standard antibiotic compounds.

The invention provides methods for screening molecules which modulate the  
15 activity of an SRT protein, either by interacting with the protein itself or a substrate or binding partner of the SRT protein, or by modulating the transcription or translation of SRT nucleic acid molecule of the invention. In such methods, a microorganism expressing one or more SRT proteins of the invention is contacted with one or more test compounds, and the effect of each test compound on the activity or level of expression  
20 of the SRT protein is assessed.

Manipulation of the SRT nucleic acid molecules of the invention may result in the production of SRT proteins having functional differences from the wild-type SRT proteins. These proteins may be improved in efficiency or activity, may be present in greater numbers in the cell than is usual, or may be decreased in efficiency or activity.  
25 The goal of such manipulations is to increase the viability and activity of the cell when the cell is exposed to the environmental and chemical stresses and hazards which frequently accompany large-scale fermentative culture. Thus, by increasing the activity or copy number of a heat-shock-regulated protease, one may increase the ability of the cell to destroy incorrectly folded proteins, which may otherwise interfere with normal  
30 cellular functioning (for example, by continuing to bind substrates or cofactors although the protein lacks the activity to act on these molecules appropriately). The same is true for the overexpression or optimization of activity of one or more chaperone molecules

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induced by heat or cold shock. These proteins aid in the correct folding of nascent polypeptide chains, and thus their increased activity or presence should increase the percentage of correctly folded proteins in the cell, which in turn should increase the overall metabolic efficiency and viability of the cells in culture. The overexpression or  
5 optimization of the transporter molecules activated by osmotic shock should result in an increased ability on the part of the cell to maintain intracellular homeostasis, thereby increasing the viability of these cells in culture. Similarly, the overproduction or increase in activity by mutagenesis of proteins involved in the development of cellular resistance to chemical stresses of various kinds (either by transport of the offending  
10 chemical out of the cell or by modification of the chemical to a less hazardous substance) should increase the fitness of the organism in the environment containing the hazardous substance (*i.e.*, large-scale fermentative culture), and thereby may permit relatively larger numbers of cells to survive in such a culture. The net effect of all of these mutagenesis strategies is to increase the quantity of fine-chemical-producing  
15 compounds in the culture, thereby increasing the yield, production, and/or efficiency of production of one or more desired fine chemicals from the culture.

This aforementioned list of mutagenesis strategies for SRT proteins to result in increased yields of a desired compound is not meant to be limiting; variations on these mutagenesis strategies will be readily apparent to one of ordinary skill in the art. By  
20 these mechanisms, the nucleic acid and protein molecules of the invention may be utilized to generate *C. glutamicum* or related strains of bacteria expressing mutated SRT nucleic acid and protein molecules such that the yield, production, and/or efficiency of production of a desired compound is improved. This desired compound may be any natural product of *C. glutamicum*, which includes the final products of biosynthesis  
25 pathways and intermediates of naturally-occurring metabolic pathways, as well as molecules which do not naturally occur in the metabolism of *C. glutamicum*, but which are produced by a *C. glutamicum* strain of the invention.

This invention is further illustrated by the following examples which should not be construed as limiting. The contents of all references, patent applications, patents,  
30 published patent applications, Tables, and the sequence listing cited throughout this application are hereby incorporated by reference.

TABLE 1: Genes Included in the Application

Nucleic Acid SEQ ID NO	Amino Acid SEQ ID NO	Identification Code	Contig.	NT Start	NT Stop	Function
1	2	RXA01524	GR00424	29041	30483	Lincomycine RESISTANCE PROTEIN
3	4	RXA00497	GR00124	52	348	10 KD CHAPERONIN
5	6	RXN00493	VV0086	14389	16002	60 KD CHAPERONIN
7	8	F RXA00498	GR00124	363	1601	60 KD CHAPERONIN
9	10	RXA01217	GR00353	802	203	GENERAL STRESS PROTEIN CTC
11	12	RXA00605	GR00159	7412	5865	CATALASE (EC 1.11.1.6)
13	14	RXA00404	GR00089	2909	594	CARBON STARVATION PROTEIN A
15	16	RXN03119	VV0098	86877	87008	SUPEROXIDE DISMUTASE [MN] (EC 1.15.1.1)
17	18	RXN03120	VV0098	87351	87476	SUPEROXIDE DISMUTASE [MN] (EC 1.15.1.1)
19	20	RXN00575	VV0323	14716	15252	PHOSPHINOTHRICIN-RESISTANCE PROTEIN
21	22	F RXA00575	GR00156	2130	1648	PHOSPHINOTHRICIN-RESISTANCE PROTEIN

Chaperones

Nucleic Acid SEQ ID NO	Amino Acid SEQ ID NO	Identification Code	Contig.	NT Start	NT Stop	Function
23	24	RXN01345	VV0123	4883	3432	Molecular chaperon (HSP70/DnaK family)
25	26	F RXA01345	GR00391	1172	6	Molecular chaperones (HSP70/DnaK family)
27	28	RXA02541	GR00726	13657	12473	DNAJ PROTEIN
29	30	RXA02542	GR00726	14518	13865	GRPE PROTEIN
31	32	RXN02543	VV0057	22031	20178	DNAK PROTEIN
33	34	F RXA02543	GR00726	16375	14522	DNAK PROTEIN
35	36	RXN02280	VV0152	1849	26	TRAP1
37	38	F RXA02282	GR00659	1145	1480	Molecular chaperone, HSP90 family
39	40	RXA00886	GR00242	12396	13541	DNAJ PROTEIN
41	42	RXS00568	VV0251	2928	1582	TRIGGER FACTOR
43	44	RXN03038	VV0017	42941	43666	PS1 PROTEIN VORLÄUFER
45	46	RXN03039	VV0018	2	631	PS1 PROTEIN VORLÄUFER
47	48	RXN03040	VV0018	761	1069	PS1 PROTEIN VORLÄUFER
49	50	RXN03051	VV0022	2832	3566	PS1 PROTEIN VORLÄUFER
51	52	RXN03054	VV0026	1906	3486	PS1 PROTEIN VORLÄUFER
53	54	RXN02949	VV0025	31243	31575	PREPROTEIN TRANSLOKASE SECE UNTEREINHEIT
55	56	RXN02462	VV0124	11932	13749	PREPROTEIN TRANSLOKASE SECA UNTEREINHEIT
57	58	RXN01559	VV0171	7795	5954	PROTEIN-EXPORT MEMBRANE PROTEIN SECD
59	60	RXN00046	VV0119	5363	6058	Signal Erkennung particle GTPase
61	62	RXN01863	VV0206	1172	24	/O/C Thioedoxin-ähnliche oxidoreductase
63	64	RXN00833	VV0180	8039	8533	THIOL PEROXIDASE (EC 1.11.1.-)

Table 1 (continued)

<u>Nucleic Acid SEQ ID NO</u>	<u>Amino Acid SEQ ID NO</u>	<u>Identification Code</u>	<u>Contig.</u>	<u>NT Start</u>	<u>NT Stop</u>	<u>Function</u>
65	66	RXN01676	VV0179	12059	11304	THIOL:DISULFIDE AUSTAUSCH PROTEIN DSB
67	68	RXN00380	VV0223	836	216	THIOL:DISULFIDE AUSTAUSCH PROTEIN TLPA
69	70	RXN00937	VV0079	42335	42706	THIOREDOXIN
71	72	RXN02325	VV0047	5527	6393	THIOREDOXIN
73	74	RXN01837	VV0320	7103	7879	PEPTIDYL-PROLYL CIS-TRANS ISOMERASE (EC 5.2.1.8)
75	76	RXN01926	VV0284	1	741	PEPTID KETTE RELEASE FACTOR 3
77	78	RXN02002	VV0111	141	518	PEPTID KETTE RELEASE FACTOR 3
79	80	RXN02736	VV0074	13600	14556	PUTATIVES OXPPCYCLE PROTEIN OPCA
81	82	RXS03217				SMALL COLD-SHOCK PROTEIN
83	84	F RXA01917	GR00549	3465	3665	SMALL COLD-SHOCK PROTEIN

Proteins involved in stress responses

<u>Nucleic Acid SEQ ID NO</u>	<u>Amino Acid SEQ ID NO</u>	<u>Identification Code</u>	<u>Contig.</u>	<u>NT Start</u>	<u>NT Stop</u>	<u>Function</u>
85	86	RXA02184	GR00641	19628	19248	COLD SHOCK-LIKE PROTEIN CSPC
87	88	RXA00810	GR00218	792	992	SMALL COLD-SHOCK PROTEIN
89	90	RXA01674	GR00467	1878	2771	PROBABLE HYDROGEN PEROXIDE-INDUCIBLE GENES ACTIVATOR
91	92	RXA02431	GR00708	2	1192	damage-inducible protein P
93	94	RXA02446	GR00709	11640	11206	OSMOTICALLY INDUCIBLE PROTEIN C
95	96	RXA02861	GR10006	551	1633	probable metallothionein u0308aa - Mycobacterium leprae
97	98	RXA00981	GR00276	3388	4017	GTP PYROPHOSPHOKINASE (EC 2.7.6.5)
99	100	RXN00786	VV0321	1680	706	LYTB PROTEIN
101	102	RXS01027	VV0143	5761	6768	DIADENOSINE 5',5'''-P1,P4-TETRAPHOSPHATE HYDROLASE (EC 3.6.1.17)
103	104	RXS01528	VV0050	17276	16749	DIADENOSINE 5',5'''-P1,P4-TETRAPHOSPHATE HYDROLASE (EC 3.6.1.17)
105	106	RXS01716	VV0319	3259	2774	EXOPOLYPHOSPHATASE (EC 3.6.1.11)
107	108	RXS01835	VV0143	10575	10045	GUANOSINE-3',5'-BIS(DIPHOSPHATE) 3'-PYROPHOSPHOHYDROLASE (EC 3.1.7.2)
109	110	RXS02497	VV0007	15609	16535	EXOPOLYPHOSPHATASE (EC 3.6.1.11)
111	112	RXS02972	VV0319	2763	2353	EXOPOLYPHOSPHATASE (EC 3.6.1.11)

Resistance and tolerance

<u>Nucleic Acid SEQ ID NO</u>	<u>Amino Acid SEQ ID NO</u>	<u>Identification Code</u>	<u>Contig.</u>	<u>NT Start</u>	<u>NT Stop</u>	<u>Function</u>
113	114	RXA02159	GR00640	6231	6743	ARGININE HYDROXIMATE RESISTANCE PROTEIN
115	116	RXA02201	GR00646	5837	6199	ARSENATE REDUCTASE
117	118	RXA00599	GR00159	1843	1457	ARSENICAL-RESISTANCE PROTEIN ACR3
119	120	RXA00600	GR00159	2940	1843	ARSENICAL-RESISTANCE PROTEIN ACR3
121	122	RXA02200	GR00646	4651	5760	ARSENICAL-RESISTANCE PROTEIN ACR3
123	124	RXA02202	GR00646	6278	6916	ARSENICAL-RESISTANCE PROTEIN ACR3
125	126	RXA02205	GR00646	9871	8993	BACITRACIN RESISTANCE PROTEIN (PUTATIVE UNDECAPRENOL KINASE) (EC 2.7.1.66)
127	128	RXA00900	GR00245	4052	3201	BICYCLOMYCIN RESISTANCE PROTEIN



Table 1 (continued)

Nucleic Acid SEQ ID NO	Amino Acid SEQ ID NO	Identification Code	Config.		NT Start		NT Stop		Function
129	130	RXN00901	VV0140	8581	8168				BICYCLOMYCIN RESISTANCE PROTEIN
131	132	F RXA00901	GR00245	4357	3980				BICYCLOMYCIN RESISTANCE PROTEIN
133	134	RXA00289	GR00046	3263	4438				CHLORAMPHENICOL RESISTANCE PROTEIN
135	136	RXN01984	VV0056	1515	1811				CHLORAMPHENICOL RESISTANCE PROTEIN
137	138	F RXA01984	GR00574	282	4				CHLORAMPHENICOL RESISTANCE PROTEIN
139	140	RXA00109	GR00015	1176	565				COPPER RESISTANCE PROTEIN C PRECURSOR
141	142	RXA00109	GR00015	1176	565				COPPER RESISTANCE PROTEIN C PRECURSOR
143	144	RXA00996	GR00283	1763	1023				DAUNORUBICIN RESISTANCE ATP-BINDING PROTEIN DRRA
145	146	RXN00829	VV0180	7950	5611				DAUNORUBICIN RESISTANCE PROTEIN
147	148	F RXA00829	GR00224	2	256				DAUNORUBICIN RESISTANCE PROTEIN
149	150	F RXA00834	GR00225	463	2025				DAUNORUBICIN RESISTANCE PROTEIN
151	152	RXA00995	GR00283	1023	283				DAUNORUBICIN RESISTANCE PROTEIN
153	154	RXN00803	VV0009	53858	52629				DAUNORUBICIN RESISTANCE TRANSMEMBRANE PROTEIN
155	156	F RXA00803	GR00214	4560	5162				METHYLENOMYCIN A RESISTANCE PROTEIN
157	158	RXA01407	GR00410	3918	3028				METHYLENOMYCIN A RESISTANCE PROTEIN
159	160	RXA01408	GR00410	4384	4184				METHYLENOMYCIN A RESISTANCE PROTEIN
161	162	RXN01922	VV0020	2031	3182				METHYLENOMYCIN A RESISTANCE PROTEIN
163	164	F RXA01922	GR00552	3	1109				METHYLENOMYCIN A RESISTANCE PROTEIN
165	166	RXA02060	GR00626	1	339				MYCINAMICIN-RESISTANCE PROTEIN MYRA
167	168	RXN01936	VV0127	40116	41387				MACROLIDE-EFFLUX PROTEIN
169	170	F RXA01936	GR00555	9796	8975				NICKEL RESISTANCE PROTEIN
171	172	F RXA01937	GR00555	10246	9821				NICKEL RESISTANCE PROTEIN
173	174	RXN01010	VV0209	3776	4894				QUINOLONE RESISTANCE NORA PROTEIN
175	176	F RXA01010	GR00288	774	4				QUINOLONE RESISTANCE NORA PROTEIN
177	178	RXN03142	VV0136	5754	4612				QUINOLONE RESISTANCE NORA PROTEIN
179	180	F RXA01150	GR00323	3807	2917				QUINOLONE RESISTANCE NORA PROTEIN
181	182	RXN02964	VV0102	7931	6714				QUINOLONE RESISTANCE NORA PROTEIN
183	184	F RXA02116	GR00636	911	6				QUINOLONE RESISTANCE NORA PROTEIN
185	186	RXA00858	GR00233	1680	2147				TELLURIUM RESISTANCE PROTEIN TERC
187	188	RXA02305	GR00663	2921	2070				DAUNOMYCIN C-14 HYDROXYLASE
189	190	RXA00084	GR00013	2367	1543				VIBRIOBACTIN UTILIZATION PROTEIN VIUB
191	192	RXA00843	GR00228	3236	3580				ARSENATE REDUCTASE
193	194	RXA01052	GR00296	3398	3706				MERCURIC REDUCTASE (EC 1.16.1.1)
195	196	RXA01053	GR00296	3772	4191				MERCURIC REDUCTASE (EC 1.16.1.1)
197	198	RXA01054	GR00296	4229	4717				MERCURIC REDUCTASE (EC 1.16.1.1)
199	200	RXN03123	VV0106	808	1245				HEAVY METAL TOLERANCE PROTEIN PRECURSOR
201	202	F RXA00993	GR00282	641	6				HEAVY METAL TOLERANCE PROTEIN PRECURSOR
203	204	RXA01051	GR00296	3298	2690				VANZ PROTEIN , teicoplanin resistance protein
205	206	RXN01873	VV0248	2054	819				Hypothetical Drug Resistance Protein
207	208	F RXA01873	GR00535	855	1946				Hypothetical Drug Resistance Protein
209	210	RXN00034	VV0020	16933	18381				MULTIDRUG RESISTANCE PROTEIN B
211	212	F RXA02273	GR00655	8058	9002				Hypothetical Drug Resistance Protein
213	214	RXN03075	VV0042	2491	3216				Hypothetical Drug Transporter
215	216	F RXA02907	GR10044	1395	2120				Hypothetical Drug Transporter
217	218	RXA00479	GR00119	16290	14101				Hypothetical Drug Transporter
219	220	RXN03124	VV0108	4	963				Hypothetical Drug Transporter
221	222	F RXA01180	GR00336	4	765				Hypothetical Drug Transporter

Table 1 (continued)

Nucleic Acid SEQ ID NO	Amino Acid SEQ ID NO	Identification Code	Contig.	NT Start	NT Stop	Function
223	224	RXA02586	GR00741	10296	10027	Hypothetical Drug Transporter
225	226	RXA02587	GR00741	12343	10253	Hypothetical Drug Transporter
227	228	RXN03042	VV0018	2440	1835	Hypothetical Drug Transporter
229	230	F RXA02893	GR10035	1841	1236	Hypothetical Drug Transporter
231	232	RXA01616	GR00450	1684	203	MULTIDRUG EFFLUX PROTEIN QACB
233	234	RXA01666	GR00463	2307	3683	MULTIDRUG RESISTANCE PROTEIN
235	236	RXA00062	GR00009	13252	11855	MULTIDRUG RESISTANCE PROTEIN B
237	238	RXA00215	GR00032	13834	15294	MULTIDRUG RESISTANCE PROTEIN B
239	240	RXN03064	VV0038	4892	6223	MULTIDRUG RESISTANCE PROTEIN B
241	242	F RXA00565	GR00151	4892	5884	MULTIDRUG RESISTANCE PROTEIN B
243	244	F RXA02878	GR10016	1837	1481	MULTIDRUG RESISTANCE PROTEIN B
245	246	RXA00648	GR00169	2713	1304	MULTIDRUG RESISTANCE PROTEIN B
247	248	RXN01320	VV0082	13146	11500	MULTIDRUG RESISTANCE PROTEIN B
249	250	F RXA01314	GR00382	744	4	MULTIDRUG RESISTANCE PROTEIN B
251	252	F RXA01320	GR00383	1979	1200	MULTIDRUG RESISTANCE PROTEIN B
253	254	RXN02926	VV0082	11497	9866	MULTIDRUG RESISTANCE PROTEIN B
255	256	F RXA01319	GR00383	1197	4	MULTIDRUG RESISTANCE PROTEIN B
257	258	RXA01578	GR00439	1423	29	MULTIDRUG RESISTANCE PROTEIN B
259	260	RXA02087	GR00629	7076	5730	MULTIDRUG RESISTANCE PROTEIN B
261	262	RXA02088	GR00629	8294	7080	MULTIDRUG RESISTANCE PROTEIN B
263	264	RXA00764	GR00204	3284	2169	MULTIDRUG RESISTANCE PROTEIN B
265	266	RXN03125	VV0108	972	1142	BMRU PROTEIN Bacillus subtilis bmrU, multidrug efflux transporter
267	268	RXN01553	VV0135	25201	26520	Hypothetical Drug Transporter
269	270	RXN00535	VV0219	5155	5871	Hypothetical Drug Permease
271	272	RXN00453	VV0076	1173	3521	Hypothetical Drug Resistance Protein
273	274	RXN00932	VV0171	13120	13593	Hypothetical Drug Transporter
275	276	RXN03022	VV0002	65	511	MULTIDRUG RESISTANCE PROTEIN B
277	278	RXN03151	VV0163	489	4	MYCINAMICIN-RESISTANCE PROTEIN MYRA
279	280	RXN02832	VV0358	547	5	LYSOSTAPHIN IMMUNITY FACTOR
281	282	RXN00165	VV0232	3275	1860	MULTIDRUG RESISTANCE-LIKE ATP-BINDING PROTEIN MDL
283	284	RXN01190	VV0169	8992	10338	MULTIDRUG RESISTANCE-LIKE ATP-BINDING PROTEIN MDL
285	286	RXN01102	VV0059	6128	4884	QUINOLONE RESISTANCE-NORA PROTEIN
287	288	RXN00788	VV0321	3424	3648	CHLORAMPHENICOL RESISTANCE PROTEIN
289	290	RXN02119	VV0102	11242	9602	A201A-RESISTANCE ATP-BINDING PROTEIN
291	292	RXN01605	VV0137	7124	5610	DAUNORUBICIN RESISTANCE TRANSMEMBRANE PROTEIN
293	294	RXN01091	VV0326	567	4	MAZG PROTEIN
295	296	RXS02979	VV0149	2150	2383	MERCURIC TRANSPORT PROTEIN PERIPLASMIC COMPONENT PRECURSOR
297	298	RXS02987	VV0234	527	294	MERCURIC TRANSPORT PROTEIN PERIPLASMIC COMPONENT PRECURSOR
299	300	RXS03095	VV0057	4056	4424	CADMIUM EFFLUX SYSTEM ACCESSORY PROTEIN HOMOLOG

TABLE 2 – Excluded Genes

GenBank™ Accession No.	Gene Name	Gene Function	Reference
A09073	ppg	Phosphoenol pyruvate carboxylase	Bachmann, B. et al. "DNA fragment coding for phosphoenolpyruvate carboxylase, recombinant DNA carrying said fragment, strains carrying the recombinant DNA and method for producing L-aminino acids using said strains," Patent: EP 0358940-A 3 03/21/90
A45579, A45581, A45583, A45585 A45587		Threonine dehydratase	Moeckel, B. et al. "Production of L-isoleucine by means of recombinant micro-organisms with deregulated threonine dehydratase," Patent: WO 9519442-A 5 07/20/95
AB003132	murC; ftsQ; ftsZ		Kobayashi, M. et al. "Cloning, sequencing, and characterization of the ftsZ gene from coryneform bacteria," <i>Biochem. Biophys. Res. Commun.</i> , 236(2):383-388 (1997)
AB015023	murC; ftsQ		Wachi, M. et al. "A murC gene from Coryneform bacteria," <i>Appl. Microbiol. Biotechnol.</i> , 51(2):223-228 (1999)
AB018530	ftsR		Kimura, E. et al. "Molecular cloning of a novel gene, ftsR, which rescues the detergent sensitivity of a mutant derived from <i>Brevibacterium lactofermentum</i> ," <i>Biosci. Biotechnol. Biochem.</i> , 60(10):1565-1570 (1996)
AB018531	ftsR1; ftsR2		
AB020624	murI	D-glutamate racemase	
AB023377	tkf	transketolase	
AB024708	gltB; gltD	Glutamine 2-oxoglutarate aminotransferase large and small subunits	
AB025424	acn	aconitase	
AB027714	rep	Replication protein	
AB027715	rep; aad	Replication protein; aminoglycoside adenylyltransferase	
AF005242	argC	N-acetylglutamate-5-semialdehyde dehydrogenase	
AF005635	glnA	Glutamine synthetase	
AF030405	hisF	cyclase	
AF030520	argG	Argininosuccinate synthetase	
AF031518	argF	Ornithine carbamoyltransferase	
AF036932	aroD	3-dehydroquinate dehydratase	
AF038548	pyc	Pyruvate carboxylase	

Table 2 (continued)

AF038651	dcIAE; apt; rel	Dipeptide-binding protein; adenine phosphoribosyltransferase; GTP pyrophosphokinase	Wehmeier, L. et al. "The role of the Corynebacterium glutamicum rel gene in (p)ppGpp metabolism," <i>Microbiology</i> , 144:1853-1862 (1998)
AF041436	argR	Arginine repressor	
AF045998	impA	Inositol monophosphate phosphatase	
AF048764	argH	Argininosuccinate lyase	
AF049897	argC; argJ; argB; argD; argF; argR; argG; argH	N-acetylglutamylphosphate reductase; ornithine acetyltransferase; N-acetylglutamate kinase; acetylornithine transaminase; ornithine carbamoyltransferase; arginine repressor; argininosuccinate synthase; argininosuccinate lyase	
AF050109	inhA	Enoyl-acyl carrier protein reductase	
AF050166	hisG	ATP phosphoribosyltransferase	
AF051846	hisA	Phosphoribosylformimino-5-amino-1-phosphoribosyl-4-imidazolecarboxamide isomerase	
AF052652	metA	Homoserine O-acetyltransferase	Park, S. et al. "Isolation and analysis of metA, a methionine biosynthetic gene encoding homoserine acetyltransferase in Corynebacterium glutamicum," <i>Mol. Cells</i> , 8(3):286-294 (1998)
AF053071	aroB	Dehydroquinase synthetase	
AF060558	hisH	Glutamine amidotransferase	
AF086704	hisE	Phosphoribosyl-ATP-pyrophosphohydrolase	
AF114233	aroA	5-enolpyruvylshikimate 3-phosphate synthase	
AF116184	panD	L-aspartate-alpha-decarboxylase precursor	Dusch, N. et al. "Expression of the Corynebacterium glutamicum panD gene encoding L-aspartate-alpha-decarboxylase leads to pantothenate overproduction in Escherichia coli," <i>Appl. Environ. Microbiol.</i> , 65(4):1530-1539 (1999)
AF124518	aroD; aroE	3-dehydroquinase; shikimate dehydrogenase	
AF124600	aroC; aroK; aroB; pepQ	Chorismate synthase; shikimate kinase; 3-dehydroquinase synthase; putative cytoplasmic peptidase	
AF145897	inhA		
AF145898	inhA		

Table 2 (continued)

AJ001436	ectP	Transport of ectoine, glycine betaine, proline	Peter, H. et al. "Corynebacterium glutamicum is equipped with four secondary carriers for compatible solutes: Identification, sequencing, and characterization of the proline/ectoine uptake system, ProP, and the ectoine/proline/glycine betaine carrier, EctP," <i>J. Bacteriol.</i> , 180(22):6005-6012 (1998)
AJ004934	dapD	Tetrahydrodipicolinate succinylase (incomplete)	Wehrmann, A. et al. "Different modes of diaminopimelate synthesis and their role in cell wall integrity: A study with <i>Corynebacterium glutamicum</i> ," <i>J. Bacteriol.</i> , 180(12):3159-3165 (1998)
AJ007732	ppc; secG; amt; ocd; soxA	Phosphoenolpyruvate-carboxylase; ?; high affinity ammonium uptake protein; putative ornithine-cyclodecarboxylase; sarcosine oxidase	
AJ010319	ftsY, glnB, glnD; strp; amtP	Involved in cell division; PII protein; uridylyltransferase (uridylyl-removing enzyme); signal recognition particle; low affinity ammonium uptake protein	Jakoby, M. et al. "Nitrogen regulation in <i>Corynebacterium glutamicum</i> ; Isolation of genes involved in biochemical characterization of corresponding proteins," <i>FEMS Microbiol.</i> , 173(2):303-310 (1999)
AJ132968	cat	Chloramphenicol acetyl transferase	
AJ224946	mgo	L-malate: quinone oxidoreductase	Molenaar, D. et al. "Biochemical and genetic characterization of the membrane-associated malate dehydrogenase (acceptor) from <i>Corynebacterium glutamicum</i> ," <i>Eur. J. Biochem.</i> , 254(2):395-403 (1998)
AJ238250	ndh	NADH dehydrogenase	
AJ238703	porA	Porin	Lichtinger, T. et al. "Biochemical and biophysical characterization of the cell wall porin of <i>Corynebacterium glutamicum</i> : The channel is formed by a low molecular mass polypeptide," <i>Biochemistry</i> , 37(43):15024-15032 (1998)
D17429		Transposable element IS31831	Veres et al. "Isolation and characterization of IS31831, a transposable element from <i>Corynebacterium glutamicum</i> ," <i>Mol. Microbiol.</i> , 11(4):739-746 (1994)
D84102	odhA	2-oxoglutarate dehydrogenase	Usuda, Y. et al. "Molecular cloning of the <i>Corynebacterium glutamicum</i> (Brevibacterium lactofermentum AJ12036) odhA gene encoding a novel type of 2-oxoglutarate dehydrogenase," <i>Microbiology</i> , 142:3347-3354 (1996)
E01358	hdh; hk	Homoserine dehydrogenase; homoserine kinase	Katsumata, R. et al. "Production of L-threonine and L-isoleucine," Patent: JP 1987232392-A 1 10/12/87
E01359		Upstream of the start codon of homoserine kinase gene	Katsumata, R. et al. "Production of L-threonine and L-isoleucine," Patent: JP 1987232392-A 2 10/12/87
E01375		Tryptophan operon	
E01376	trpL; trpE	Leader peptide; anthranilate synthase	Matsui, K. et al. "Tryptophan operon, peptide and protein coded thereby, utilization of tryptophan operon gene expression and production of tryptophan," Patent: JP 1987244382-A 1 10/24/87



Table 2 (continued)

	Promoter and operator regions of tryptophan operon	
E01377		Matsui, K. et al. "Tryptophan operon, peptide and protein coded thereby, utilization of tryptophan operon gene expression and production of tryptophan," Patent: JP 1987244382-A 1 10/24/87
E03937	Biotin-synthase	Hatakeyama, K. et al. "DNA fragment containing gene capable of coding biotin synthetase and its utilization," Patent: JP 1992278088-A 1 10/02/92
E04040	Diamino pelargonic acid aminotransferase	Kohama, K. et al. "Gene coding diaminopelargonic acid aminotransferase and desthiobiotin synthetase and its utilization," Patent: JP 1992330284-A 1 11/18/92
E04041	Desthiobiotinsynthetase	Kohama, K. et al. "Gene coding diaminopelargonic acid aminotransferase and desthiobiotin synthetase and its utilization," Patent: JP 1992330284-A 1 11/18/92
E04307	Flavum aspartase	Kurusu, Y. et al. "Gene DNA coding aspartase and utilization thereof," Patent: JP 1993030977-A 1 02/09/93
E04376	Isocitric acid lyase	Katsumata, R. et al. "Gene manifestation controlling DNA," Patent: JP 1993056782-A 3 03/09/93
E04377	Isocitric acid lyase N-terminal fragment	Katsumata, R. et al. "Gene manifestation controlling DNA," Patent: JP 1993056782-A 3 03/09/93
E04484	Prephenate dehydratase	Sotouchi, N. et al. "Production of L-phenylalanine by fermentation," Patent: JP 1993076352-A 2 03/30/93
E05108	Aspartokinase	Fugono, N. et al. "Gene DNA coding Aspartokinase and its use," Patent: JP 1993184366-A 1 07/27/93
E05112	Dihydro-dipichorinate synthetase	Hatakeyama, K. et al. "Gene DNA coding dihydrodipicolinic acid synthetase and its use," Patent: JP 1993184371-A 1 07/27/93
E05776	Diaminopimelic acid dehydrogenase	Kobayashi, M. et al. "Gene DNA coding Diaminopimelic acid dehydrogenase and its use," Patent: JP 1993284970-A 1 11/02/93
E05779	Threonine synthase	Kohama, K. et al. "Gene DNA coding threonine synthase and its use," Patent: JP 1993284972-A 1 11/02/93
E06110	Prephenate dehydratase	Kikuchi, T. et al. "Production of L-phenylalanine by fermentation method," Patent: JP 1993344881-A 1 12/27/93
E06111	Mutated Prephenate dehydratase	Kikuchi, T. et al. "Production of L-phenylalanine by fermentation method," Patent: JP 1993344881-A 1 12/27/93
E06146	Acetohydroxy acid synthetase	Inui, M. et al. "Gene capable of coding Acetohydroxy acid synthetase and its use," Patent: JP 1993344893-A 1 12/27/93
E06825	Aspartokinase	Sugimoto, M. et al. "Mutant aspartokinase gene," patent: JP 1994062866-A 1 03/08/94
E06826	Mutated aspartokinase alpha subunit	Sugimoto, M. et al. "Mutant aspartokinase gene," patent: JP 1994062866-A 1 03/08/94

Table 2 (continued)			
		Mutated aspartokinase alpha subunit	
E06827			Sugimoto, M. et al. "Mutant aspartokinase gene," patent: JP 1994062866-A 03/08/94
E07701	secY		Honno, N. et al. "Gene DNA participating in integration of membraneous protein to membrane," Patent: JP 1994169780-A 1 06/21/94
E08177		Aspartokinase	Sato, Y. et al. "Genetic DNA capable of coding Aspartokinase released from feedback inhibition and its utilization," Patent: JP 1994261766-A 1 09/20/94
E08178, E08179, E08180, E08181, E08182		Feedback inhibition-released Aspartokinase	Sato, Y. et al. "Genetic DNA capable of coding Aspartokinase released from feedback inhibition and its utilization," Patent: JP 1994261766-A 1 09/20/94
E08232		Acetohydroxy-acid isomeroreductase	Inui, M. et al. "Gene DNA coding acetohydroxy acid isomeroreductase," Patent: JP 1994277067-A 1 10/04/94
E08234	secE		Asai, Y. et al. "Gene DNA coding for translocation machinery of protein," Patent: JP 1994277073-A 1 10/04/94
E08643		FT aminotransferase and desthiobiotin synthetase promoter region	Hatakeyama, K. et al. "DNA fragment having promoter function in coryneform bacterium," Patent: JP 1995031476-A 1 02/03/95
E08646		Biotin synthetase	Hatakeyama, K. et al. "DNA fragment having promoter function in coryneform bacterium," Patent: JP 1995031476-A 1 02/03/95
E08649		Aspartase	Kohama, K. et al. "DNA fragment having promoter function in coryneform bacterium," Patent: JP 1995031478-A 1 02/03/95
E08900		Dihydrodipicolinate reductase	Madori, M. et al. "DNA fragment containing gene coding Dihydrodipicolinate acid reductase and utilization thereof," Patent: JP 1995075578-A 1 03/20/95
E08901		Diaminopimelic acid decarboxylase	Madori, M. et al. "DNA fragment containing gene coding Diaminopimelic acid decarboxylase and utilization thereof," Patent: JP 1995075579-A 1 03/20/95
E12594		Serine hydroxymethyltransferase	Hatakeyama, K. et al. "Production of L-tryptophan," Patent: JP 1997028391-A 1 02/04/97
E12760, E12759, E12758		transposase	Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97
E12764		Arginyl-tRNA synthetase; diaminopimelic acid decarboxylase	Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97
E12767		Dihydrodipicolinic acid synthetase	Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97
E12770		aspartokinase	Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97
E12773		Dihydrodipicolinic acid reductase	Moriya, M. et al. "Amplification of gene using artificial transposon," Patent: JP 1997070291-A 03/18/97

Table 2 (continued)

		Glucose-6-phosphate dehydrogenase	
E13655			Hatakeyama, K. et al. "Glucose-6-phosphate dehydrogenase and DNA capable of coding the same," Patent: JP 1997224661-A 1 09/02/97
L01508	ilvA	Threonine dehydratase	Moeckel, B. et al. "Functional and structural analysis of the threonine dehydratase of Corynebacterium glutamicum," <i>J. Bacteriol.</i> , 174:8065-8072 (1992)
L07603	EC 4.2.1.15	3-deoxy-D-arabinoheptulosonate-7-phosphate synthase	Chen, C. et al. "The cloning and nucleotide sequence of Corynebacterium glutamicum 3-deoxy-D-arabinoheptulosonate-7-phosphate synthase gene," <i>FEMS Microbiol. Lett.</i> , 107:223-230 (1993)
L09232	ilvB; ilvN; ilvC	Acetohydroxy acid synthase large subunit; Acetohydroxy acid synthase small subunit; Acetohydroxy acid isomeroreductase	Keilhauer, C. et al. "Isoleucine synthesis in Corynebacterium glutamicum: molecular analysis of the ilvB-ilvN-ilvC operon," <i>J. Bacteriol.</i> , 175(17):5595-5603 (1993)
L18874	PtsM	Phosphoenolpyruvate sugar phosphotransferase	Fouet, A. et al. "Bacillus subtilis sucrose-specific enzyme II of the phosphotransferase system: expression in Escherichia coli and homology to enzymes II from enteric bacteria," <i>PNAS USA</i> , 84(24):8773-8777 (1987); Lee, J.K. et al. "Nucleotide sequence of the gene encoding the Corynebacterium glutamicum mannose enzyme II and analyses of the deduced protein sequence," <i>FEMS Microbiol. Lett.</i> , 119(1-2):137-145 (1994)
L27123	aceB	Malate synthase	Lee, H-S. et al. "Molecular characterization of aceB, a gene encoding malate synthase in Corynebacterium glutamicum," <i>J. Microbiol. Biotechnol.</i> , 4(4):256-263 (1994)
L27126		Pyruvate kinase	Jetten, M. S. et al. "Structural and functional analysis of pyruvate kinase from Corynebacterium glutamicum," <i>Appl. Environ. Microbiol.</i> , 60(7):2501-2507 (1994)
L28760	aceA	Isocitrate lyase	
L35906	dtxR	Diphtheria toxin repressor	Oguiza, J.A. et al. "Molecular cloning, DNA sequence analysis, and characterization of the Corynebacterium diphtheriae dtxR from Brevibacterium lactofermentum," <i>J. Bacteriol.</i> , 177(2):465-467 (1995)
M13774		Prephenate dehydratase	Follettie, M.T. et al. "Molecular cloning and nucleotide sequence of the Corynebacterium glutamicum pheA gene," <i>J. Bacteriol.</i> , 167:695-702 (1986)
M16175	5S rRNA		Park, Y-H. et al. "Phylogenetic analysis of the coryneform bacteria by 5S rRNA sequences," <i>J. Bacteriol.</i> , 169:1801-1806 (1987)
M16663	trpE	Anthranilate synthase, 5' end	Sano, K. et al. "Structure and function of the trp operon control regions of Brevibacterium lactofermentum, a glutamic-acid-producing bacterium," <i>Gene</i> , 52:191-200 (1987)
M16664	trpA	Tryptophan synthase, 3' end	Sano, K. et al. "Structure and function of the trp operon control regions of Brevibacterium lactofermentum, a glutamic-acid-producing bacterium," <i>Gene</i> , 52:191-200 (1987)

Table 2 (continued)

		Phosphoenolpyruvate carboxylase	
M25819			O'Regan, M. et al. "Cloning and nucleotide sequence of the Phosphoenolpyruvate carboxylase-coding gene of <i>Corynebacterium glutamicum</i> ATCC13032," <i>Gene</i> , 77(2):237-251 (1989)
M85106		23S rRNA gene insertion sequence	Roller, C. et al. "Gram-positive bacteria with a high DNA G+C content are characterized by a common insertion within their 23S rRNA genes," <i>J. Gen. Microbiol.</i> , 138:1167-1175 (1992)
M85107, M85108		23S rRNA gene insertion sequence	Roller, C. et al. "Gram-positive bacteria with a high DNA G+C content are characterized by a common insertion within their 23S rRNA genes," <i>J. Gen. Microbiol.</i> , 138:1167-1175 (1992)
M89931	aecD; bmQ; yhbW	Beta C-S lyase; branched-chain amino acid uptake carrier; hypothetical protein yhbW	Rossol, I. et al. "The <i>Corynebacterium glutamicum</i> aecD gene encodes a C-S lyase with alpha, beta-elimination activity that degrades aminoethylcysteine," <i>J. Bacteriol.</i> , 174(9):2968-2977 (1992); Tauch, A. et al. "Isoleucine uptake in <i>Corynebacterium glutamicum</i> ATCC 13032 is directed by the bmQ gene product," <i>Arch. Microbiol.</i> , 169(4):303-312 (1998)
S59299	trp	Leader gene (promoter)	Herry, D.M. et al. "Cloning of the trp gene cluster from a tryptophan-hyperproducing strain of <i>Corynebacterium glutamicum</i> : identification of a mutation in the trp leader sequence," <i>Appl. Environ. Microbiol.</i> , 59(3):791-799 (1993)
U11545	trpD	Anthranelate phosphoribosyltransferase	O'Gara, J.P. and Dunican, L.K. (1994) Complete nucleotide sequence of the <i>Corynebacterium glutamicum</i> ATCC 21850 trpD gene." Thesis, Microbiology Department, University College Galway, Ireland.
U13922	cglIM; cglIR; cglIR	Putative type II 5-cytosine methyltransferase; putative type II restriction endonuclease; putative type I or type III restriction endonuclease	Schafer, A. et al. "Cloning and characterization of a DNA region encoding a stress-sensitive restriction system from <i>Corynebacterium glutamicum</i> ATCC 13032 and analysis of its role in intergeneric conjugation with <i>Escherichia coli</i> ," <i>J. Bacteriol.</i> , 176(23):7309-7319 (1994); Schafer, A. et al. "The <i>Corynebacterium glutamicum</i> cglIM gene encoding a 5-cytosine in an McrBC-deficient <i>Escherichia coli</i> strain," <i>Gene</i> , 203(2):95-101 (1997)
U14965	recA		
U31224	ppx		Ankri, S. et al. "Mutations in the <i>Corynebacterium glutamicum</i> proline biosynthetic pathway: A natural bypass of the proA step," <i>J. Bacteriol.</i> , 178(15):4412-4419 (1996)
U31225	proC	L-proline: NADP+ 5-oxidoreductase	Ankri, S. et al. "Mutations in the <i>Corynebacterium glutamicum</i> proline biosynthetic pathway: A natural bypass of the proA step," <i>J. Bacteriol.</i> , 178(15):4412-4419 (1996)
U31230	obg; proB; unkdh	?; gamma glutamyl kinase; similar to D-isomer specific 2-hydroxyacid dehydrogenases	Ankri, S. et al. "Mutations in the <i>Corynebacterium glutamicum</i> proline biosynthetic pathway: A natural bypass of the proA step," <i>J. Bacteriol.</i> , 178(15):4412-4419 (1996)



Table 2 (continued)

U31281	bioB	Biotin synthase	Serebriiskii, I.G., "Two new members of the bio B superfamily: Cloning, sequencing and expression of bio B genes of Methylobacillus flagellatum and Corynebacterium glutamicum," <i>Gene</i> , 175:15-22 (1996)
U35023	thtR; accBC	Thiosulfate sulfurtransferase; acyl CoA carboxylase	Jager, W. et al. "A Corynebacterium glutamicum gene encoding a two-domain protein similar to biotin carboxylases and biotin-carboxyl-carrier proteins," <i>Arch. Microbiol.</i> , 166(2):76-82 (1996)
U43535	cmr	Multidrug resistance protein	Jager, W. et al. "A Corynebacterium glutamicum gene conferring multidrug resistance in the heterologous host <i>Escherichia coli</i> ," <i>J. Bacteriol.</i> , 179(7):2449-2451 (1997)
U43536	clpB	Heat shock ATP-binding protein	
U53587	aphA-3	3'5'-aminoglycoside phosphotransferase	
U89648		Corynebacterium glutamicum unidentified sequence involved in histidine biosynthesis, partial sequence	
X04960	trpA; trpB; trpC; trpD; trpE; trpG; trpL	Tryptophan operon	Matsui, K. et al. "Complete nucleotide and deduced amino acid sequences of the <i>Brevibacterium lactofermentum</i> tryptophan operon," <i>Nucleic Acids Res.</i> , 14(24):10113-10114 (1986)
X07563	lys A	DAP decarboxylase (meso-diaminopimelate decarboxylase, EC 4.1.1.20)	Yeh, P. et al. "Nucleic sequence of the lysA gene of Corynebacterium glutamicum and possible mechanisms for modulation of its expression," <i>Mol. Gen. Genet.</i> , 212(1):112-119 (1988)
X14234	EC 4.1.1.31	Phosphoenolpyruvate carboxylase	Eikmanns, B.J. et al. "The Phosphoenolpyruvate carboxylase gene of Corynebacterium glutamicum: Molecular cloning, nucleotide sequence, and expression," <i>Mol. Gen. Genet.</i> , 218(2):330-339 (1989); Lepiniec, L. et al. "Sorghum Phosphoenolpyruvate carboxylase gene family: structure, function and molecular evolution," <i>Plant. Mol. Biol.</i> , 21 (3):487-502 (1993)
X17313	fda	Fructose-bisphosphate aldolase	Von der Osten, C.H. et al. "Molecular cloning, nucleotide sequence and fine-structural analysis of the Corynebacterium glutamicum fda gene: structural comparison of C. glutamicum fructose-1, 6-bisphosphate aldolase to class I and class II aldolases," <i>Mol. Microbiol.</i>
X53993	dapA	L-2, 3-dihydrodipicolinate synthetase (EC 4.2.1.52)	Bonnassie, S. et al. "Nucleic sequence of the dapA gene from Corynebacterium glutamicum," <i>Nucleic Acids Res.</i> , 18(21):6421 (1990)
X54223		AttB-related site	Cianciotto, N. et al. "DNA sequence homology between att B-related sites of Corynebacterium diphtheriae, Corynebacterium ulcerans, Corynebacterium glutamicum, and the attP site of lambdacorynebophage," <i>FEMS. Microbiol. Lett.</i> , 66:299-302 (1990)
X54740	argS; lysA	Arginyl-tRNA synthetase; Diaminopimelate decarboxylase	Marcel, T. et al. "Nucleotide sequence and organization of the upstream region of the Corynebacterium glutamicum lysA gene," <i>Mol. Microbiol.</i> , 4(11):1819-1830 (1990)



Table 2 (continued)

X55994	trpL; trpE	Putative leader peptide; anthranilate synthase component I	Heery, D.M. et al. "Nucleotide sequence of the Corynebacterium glutamicum trpE gene," <i>Nucleic Acids Res.</i> , 18(23):7138 (1990)
X56037	thrC	Threonine synthase	Han, K.S. et al. "The molecular structure of the Corynebacterium glutamicum threonine synthase gene," <i>Mol. Microbiol.</i> , 4(10):1693-1702 (1990)
X56075	attB-related site	Attachment site	Cianciotto, N. et al. "DNA sequence homology between att B-related sites of Corynebacterium diphtheriae, Corynebacterium ulcerans, Corynebacterium glutamicum, and the attP site of lambdaCorynebacteriophage," <i>FEMS. Microbiol. Lett.</i> , 66:299-302 (1990)
X57226	lysC-alpha; lysC-beta; asd	Aspartokinase-alpha subunit; Aspartokinase-beta subunit; aspartate beta semialdehyde dehydrogenase	Kalinowski, J. et al. "Genetic and biochemical analysis of the Aspartokinase from Corynebacterium glutamicum," <i>Mol. Microbiol.</i> , 5(5):1197-1204 (1991); Kalinowski, J. et al. "Aspartokinase genes lysC alpha and lysC beta overlap and are adjacent to the aspartate beta-semialdehyde dehydrogenase gene asd in Corynebacterium glutamicum," <i>Mol. Gen. Genet.</i> , 224(3):317-324 (1990)
X59403	gap; pgk; tpi	Glyceraldehyde-3-phosphate; phosphoglycerate kinase; triosephosphate isomerase	Eikmanns, B.J. "Identification, sequence analysis, and expression of a Corynebacterium glutamicum gene cluster encoding the three glycolytic enzymes glyceraldehyde-3-phosphate dehydrogenase, 3-phosphoglycerate kinase, and triosephosphate isomerase," <i>J. Bacteriol.</i> , 174(19):6076-6086 (1992)
X59404	gdh	Glutamate dehydrogenase	Bormann, E.R. et al. "Molecular analysis of the Corynebacterium glutamicum gdh gene encoding glutamate dehydrogenase," <i>Mol. Microbiol.</i> , 6(3):317-326 (1992)
X60312	lysI	L-lysine permease	Seep-Feldhaus, A.H. et al. "Molecular analysis of the Corynebacterium glutamicum lysI gene involved in lysine uptake," <i>Mol. Microbiol.</i> , 5(12):2995-3005 (1991)
X66078	copI	Psl protein	Joliff, G. et al. "Cloning and nucleotide sequence of the cspI gene encoding Psl, one of the two major secreted proteins of Corynebacterium glutamicum: The deduced N-terminal region of Psl is similar to the Mycobacterium antigen 85 complex," <i>Mol. Microbiol.</i> , 6(16):2349-2362 (1992)
X66112	glt	Citrate synthase	Eikmanns, B.J. et al. "Cloning sequence, expression and transcriptional analysis of the Corynebacterium glutamicum gltA gene encoding citrate synthase," <i>Microbiol.</i> , 140:1817-1828 (1994)
X67737	dapB	Dihydrodipicolinate reductase	
X69103	csp2	Surface layer protein PS2	Peyret, J.L. et al. "Characterization of the cspB gene encoding PS2, an ordered surface-layer protein in Corynebacterium glutamicum," <i>Mol. Microbiol.</i> , 9(1):97-109 (1993)
X69104		IS3 related insertion element	Bonamy, C. et al. "Identification of IS1206, a Corynebacterium glutamicum IS3-related insertion sequence and phylogenetic analysis," <i>Mol. Microbiol.</i> , 14(3):571-581 (1994)

Table 2 (continued)

X70959	leuA	Isopropylmalate synthase	Patek, M. et al. "Leucine synthesis in <i>Corynebacterium glutamicum</i> : enzyme activities, structure of leuA, and effect of leuA inactivation on lysine synthesis," <i>Appl. Environ. Microbiol.</i> , 60(1):133-140 (1994)
X71489	icd	Isocitrate dehydrogenase (NADP+)	Eikmanns, B.J. et al. "Cloning sequence analysis, expression, and inactivation of the <i>Corynebacterium glutamicum</i> icd gene encoding isocitrate dehydrogenase and biochemical characterization of the enzyme," <i>J. Bacteriol.</i> , 177(3):774-782 (1995)
X72855	GDHA	Glutamate dehydrogenase (NADP+)	
X75083, X70584	mtrA	5-methyltryptophan resistance	Heery, D.M. et al. "A sequence from a tryptophan-hyperproducing strain of <i>Corynebacterium glutamicum</i> encoding resistance to 5-methyltryptophan," <i>Biochem. Biophys. Res. Commun.</i> , 201(3):1255-1262 (1994)
X75085	recA		Fitzpatrick, R. et al. "Construction and characterization of recA mutant strains of <i>Corynebacterium glutamicum</i> and <i>Brevibacterium lactofermentum</i> ," <i>Appl. Microbiol. Biotechnol.</i> , 42(4):575-580 (1994)
X75504	aceA; thiX	Partial Isocitrate lyase; ?	Reinscheid, D.J. et al. "Characterization of the isocitrate lyase gene from <i>Corynebacterium glutamicum</i> and biochemical analysis of the enzyme," <i>J. Bacteriol.</i> , 176(12):3474-3483 (1994)
X76875		ATPase beta-subunit	Ludwig, W. et al. "Phylogenetic relationships of bacteria based on comparative sequence analysis of elongation factor Tu and ATP-synthase beta-subunit genes," <i>Antonie Van Leeuwenhoek</i> , 64:285-305 (1993)
X77034	tuf	Elongation factor Tu	Ludwig, W. et al. "Phylogenetic relationships of bacteria based on comparative sequence analysis of elongation factor Tu and ATP-synthase beta-subunit genes," <i>Antonie Van Leeuwenhoek</i> , 64:285-305 (1993)
X77384	recA		Billman-Jacobe, H. "Nucleotide sequence of a recA gene from <i>Corynebacterium glutamicum</i> ," <i>DNA Seq.</i> , 4(6):403-404 (1994)
X78491	aceB	Malate synthase	Reinscheid, D.J. et al. "Malate synthase from <i>Corynebacterium glutamicum</i> pta-ack operon encoding phosphotransacetylase: sequence analysis," <i>Microbiology</i> , 140:3099-3108 (1994)
X80629	16S rDNA	16S ribosomal RNA	Rainey, F.A. et al. "Phylogenetic analysis of the genera <i>Rhodococcus</i> and <i>Norcardia</i> and evidence for the evolutionary origin of the genus <i>Norcardia</i> from within the radiation of <i>Rhodococcus</i> species," <i>Microbiol.</i> , 141:523-528 (1995)
X81191	gluA; gluB; gluC; gluD	Glutamate uptake system	Kronmeyer, W. et al. "Structure of the gluABCD cluster encoding the glutamate uptake system of <i>Corynebacterium glutamicum</i> ," <i>J. Bacteriol.</i> , 177(5):1152-1158 (1995)
X81379	dapE	Succinyldiaminopimelate desuccinylase	Wehrmann, A. et al. "Analysis of different DNA fragments of <i>Corynebacterium glutamicum</i> complementing dapE of <i>Escherichia coli</i> ," <i>Microbiology</i> , 40:3349-56 (1994)

Table 2 (continued)

	16S rDNA	16S ribosomal RNA	
X82061			Ruimy, R. et al. "Phylogeny of the genus <i>Corynebacterium</i> deduced from analyses of small-subunit ribosomal DNA sequences," <i>Int. J. Syst. Bacteriol.</i> , 45(4):740-746 (1995)
X82928	asd; lysC	Aspartate-semialdehyde dehydrogenase; ?	Serebrijski, I. et al. "Multicopy suppression by asd gene and osmotic stress-dependent complementation by heterologous proA in proA mutants," <i>J. Bacteriol.</i> , 177(24):7255-7260 (1995)
X82929	proA	Gamma-glutamyl phosphate reductase	Serebrijski, I. et al. "Multicopy suppression by asd gene and osmotic stress-dependent complementation by heterologous proA in proA mutants," <i>J. Bacteriol.</i> , 177(24):7255-7260 (1995)
X84257	16S rDNA	16S ribosomal RNA	Pascual, C. et al. "Phylogenetic analysis of the genus <i>Corynebacterium</i> based on 16S rRNA gene sequences," <i>Int. J. Syst. Bacteriol.</i> , 45(4):724-728 (1995)
X85965	aroP; dapE	Aromatic amino acid permease; ?	Wehrmann et al. "Functional analysis of sequences adjacent to dapE of <i>C. glutamicum</i> proline reveals the presence of aroP, which encodes the aromatic amino acid transporter," <i>J. Bacteriol.</i> , 177(20):5991-5993 (1995)
X86157	argB; argC; argD; argF; argJ	Acetylglutamate kinase; N-acetyl-gamma-glutamyl-phosphate reductase; acetylornithine aminotransferase; ornithine carbamoyltransferase; glutamate N-acetyltransferase	Sakanyan, V. et al. "Genes and enzymes of the acetyl cycle of arginine biosynthesis in <i>Corynebacterium glutamicum</i> : enzyme evolution in the early steps of the arginine pathway," <i>Microbiology</i> , 142:99-108 (1996)
X89084	pta; ackA	Phosphate acetyltransferase; acetate kinase	Reinscheid, D.J. et al. "Cloning, sequence analysis, expression and inactivation of the <i>Corynebacterium glutamicum</i> pta-ack operon encoding phosphotransacetylase and acetate kinase," <i>Microbiology</i> , 145:503-513 (1999)
X89850	attB	Attachment site	Le Marrec, C. et al. "Genetic characterization of site-specific integration functions of phi AAU2 infecting 'Arthrobacter aureus C70,'" <i>J. Bacteriol.</i> , 178(7):1996-2004 (1996)
X90356		Promoter fragment F1	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90357		Promoter fragment F2	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90358		Promoter fragment F10	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90359		Promoter fragment F13	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)

Table 2 (continued)

X90360		Promoter fragment F22	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90361		Promoter fragment F34	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90362		Promoter fragment F37	Patek, M. et al. "Promoters from <i>C. glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90363		Promoter fragment F45	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90364		Promoter fragment F64	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90365		Promoter fragment F75	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90366		Promoter fragment PF101	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90367		Promoter fragment PF104	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X90368		Promoter fragment PF109	Patek, M. et al. "Promoters from <i>Corynebacterium glutamicum</i> : cloning, molecular analysis and search for a consensus motif," <i>Microbiology</i> , 142:1297-1309 (1996)
X93513	amt	Ammonium transport system	Siewe, R.M. et al. "Functional and genetic characterization of the (methyl) ammonium uptake carrier of <i>Corynebacterium glutamicum</i> ," <i>J. Biol. Chem.</i> , 271(10):5398-5403 (1996)
X93514	betP	Glycine betaine transport system	Peter, H. et al. "Isolation, characterization, and expression of the <i>Corynebacterium glutamicum</i> betP gene, encoding the transport system for the compatible solute glycine betaine," <i>J. Bacteriol.</i> , 178(17):5229-5234 (1996)
X95649	orf4		Patek, M. et al. "Identification and transcriptional analysis of the dapB-ORF2-dapA-ORF4 operon of <i>Corynebacterium glutamicum</i> , encoding two enzymes involved in L-lysine synthesis," <i>Biotechnol. Lett.</i> , 19:1113-1117 (1997)
X96471	lysE; lysG	Lysine exporter protein; Lysine export regulator protein	Vrljic, M. et al. "A new type of transporter with a new type of cellular function: L-lysine export from <i>Corynebacterium glutamicum</i> ," <i>Mol. Microbiol.</i> , 22(5):815-826 (1996)



Table 2 (continued)

X96580	panB; panC; xyIB	3-methyl-2-oxobutanoate hydroxymethyltransferase; pantoate-beta-alanine ligase; xylulokinase	Sahm, H. et al. "D-pantothenate synthesis in Corynebacterium glutamicum and use of panBC and genes encoding L-valine synthesis for D-pantothenate overproduction," <i>Appl. Environ. Microbiol.</i> , 65(5):1973-1979 (1999)
X96962		Insertion sequence IS1207 and transposase	
X99289		Elongation factor P	Ramos, A. et al. "Cloning, sequencing and expression of the gene encoding elongation factor P in the amino-acid producer Brevibacterium lactofermentum (Corynebacterium glutamicum ATCC 13869)," <i>Gene</i> , 198:217-222 (1997)
Y00140	thrB	Homoserine kinase	Mateos, L.M. et al. "Nucleotide sequence of the homoserine kinase (thrB) gene of the Brevibacterium lactofermentum," <i>Nucleic Acids Res.</i> , 15(9):3922 (1987)
Y00151	ddh	Meso-diaminopimelate D-dehydrogenase (EC 1.4.1.16)	Ishino, S. et al. "Nucleotide sequence of the meso-diaminopimelate D-dehydrogenase gene from Corynebacterium glutamicum," <i>Nucleic Acids Res.</i> , 15(9):3917 (1987)
Y00476	thrA	Homoserine dehydrogenase	Mateos, L.M. et al. "Nucleotide sequence of the homoserine dehydrogenase (thrA) gene of the Brevibacterium lactofermentum," <i>Nucleic Acids Res.</i> , 15(24):10598 (1987)
Y00546	hom; thrB	Homoserine dehydrogenase; homoserine kinase	Peoples, O.P. et al. "Nucleotide sequence and fine structural analysis of the Corynebacterium glutamicum hom-thrB operon," <i>Mol. Microbiol.</i> , 2(1):63-72 (1988)
Y08964	murC; ftsQ/divD; ftsZ	UPD-N-acetylmuramate-alanine ligase; division initiation protein or cell division protein; cell division protein	Honrubia, M.P. et al. "Identification, characterization, and chromosomal organization of the ftsZ gene from Brevibacterium lactofermentum," <i>Mol. Gen. Genet.</i> , 259(1):97-104 (1998)
Y09163	putP	High affinity proline transport system	Peter, H. et al. "Isolation of the putP gene of Corynebacterium glutamicumproline and characterization of a low-affinity uptake system for compatible solutes," <i>Arch. Microbiol.</i> , 168(2):143-151 (1997)
Y09548	pyc	Pyruvate carboxylase	Peters-Wendisch, P.G. et al. "Pyruvate carboxylase from Corynebacterium glutamicum: characterization, expression and inactivation of the pyc gene," <i>Microbiology</i> , 144:915-927 (1998)
Y09578	leuB	3-isopropylmalate dehydrogenase	Patek, M. et al. "Analysis of the leuB gene from Corynebacterium glutamicum," <i>Appl. Microbiol. Biotechnol.</i> , 50(1):42-47 (1998)
Y12472		Attachment site bacteriophage Phi-16	Moreau, S. et al. "Site-specific integration of coryneophage Phi-16: The construction of an integration vector," <i>Microbiol.</i> , 145:539-548 (1999)
Y12537	proP	Proline/ectoine uptake system protein	Peter, H. et al. "Corynebacterium glutamicum is equipped with four secondary carriers for compatible solutes: Identification, sequencing, and characterization of the proline/ectoine uptake system, ProP, and the ectoine/proline/glycine betaine carrier, EctP," <i>J. Bacteriol.</i> , 180(22):6005-6012 (1998)



Table 2 (continued)

Y13221	glnA	Glutamine synthetase I	Jakoby, M. et al. "Isolation of <i>Corynebacterium glutamicum</i> glnA gene encoding glutamine synthetase I," <i>FEMS Microbiol. Lett.</i> , 154(1):81-88 (1997)
Y16642	lpd	Dihydrolipoamide dehydrogenase	
Y18059		Attachment site Corynebacterium 304L	Moreau, S. et al. "Analysis of the integration functions of &phi;304L: An integrase module among corynebacteriophages," <i>Virology</i> , 255(1):150-159 (1999)
Z21501	argS; lysA	Arginyl-tRNA synthetase; diaminopimelate decarboxylase (partial)	Oguiza, J.A. et al. "A gene encoding arginyl-tRNA synthetase is located in the upstream region of the lysA gene in <i>Brevibacterium lactofermentum</i> : Regulation of argS-lysA cluster expression by arginine," <i>J. Bacteriol.</i> , 175(22):7356-7362 (1993)
Z21502	dapA; dapB	Dihydrodipicolinate synthase; dihydrodipicolinate reductase	Pisabarro, A. et al. "A cluster of three genes (dapA, orf2, and dapB) of <i>Brevibacterium lactofermentum</i> encodes dihydrodipicolinate reductase, and a third polypeptide of unknown function," <i>J. Bacteriol.</i> , 175(9):2743-2749 (1993)
Z29563	thrC	Threonine synthase	Malumbres, M. et al. "Analysis and expression of the thrC gene of the encoded threonine synthase," <i>Appl. Environ. Microbiol.</i> , 60(7):2209-2219 (1994)
Z46753	16S rDNA	Gene for 16S ribosomal RNA	
Z49822	sigA	SigA sigma factor	Oguiza, J.A. et al. "Multiple sigma factor genes in <i>Brevibacterium lactofermentum</i> : Characterization of sigA and sigB," <i>J. Bacteriol.</i> , 178(2):550-553 (1996)
Z49823	galE; dtxR	Catalytic activity UDP-galactose 4-epimerase; diphtheria toxin regulatory protein	Oguiza, J.A. et al. "The galE gene encoding the UDP-galactose 4-epimerase of <i>Brevibacterium lactofermentum</i> is coupled transcriptionally to the dmdR gene," <i>Gene</i> , 177:103-107 (1996)
Z49824	orf1; sigB	?; SigB sigma factor	Oguiza, J.A. et al. "Multiple sigma factor genes in <i>Brevibacterium lactofermentum</i> : Characterization of sigA and sigB," <i>J. Bacteriol.</i> , 178(2):550-553 (1996)
Z66534		Transposase	Correia, A. et al. "Cloning and characterization of an IS-like element present in the genome of <i>Brevibacterium lactofermentum</i> ATCC 13869," <i>Gene</i> , 170(1):91-94 (1996)
A sequence for this gene was published in the indicated reference. However, the sequence obtained by the inventors of the present application is significantly longer than the published version. It is believed that the published version relied on an incorrect start codon, and thus represents only a fragment of the actual coding region.			

TABLE 3: Corynebacterium and Brevibacterium Strains Which May be Used in the Practice of the Invention

Genus	species	ATCC	FERM	NRRL	CECT	NCIMB	CBS	NCTC	DSMZ
Brevibacterium	ammoniagenes	21054							
Brevibacterium	ammoniagenes	19350							
Brevibacterium	ammoniagenes	19351							
Brevibacterium	ammoniagenes	19352							
Brevibacterium	ammoniagenes	19353							
Brevibacterium	ammoniagenes	19354							
Brevibacterium	ammoniagenes	19355							
Brevibacterium	ammoniagenes	19356							
Brevibacterium	ammoniagenes	21055							
Brevibacterium	ammoniagenes	21077							
Brevibacterium	ammoniagenes	21553							
Brevibacterium	ammoniagenes	21580							
Brevibacterium	ammoniagenes	39101							
Brevibacterium	butanicum	21196							
Brevibacterium	divaricatum	21792	P928						
Brevibacterium	flavum	21474							
Brevibacterium	flavum	21129							
Brevibacterium	flavum	21518							
Brevibacterium	flavum			B11474					
Brevibacterium	flavum			B11472					
Brevibacterium	flavum	21127							
Brevibacterium	flavum	21128							
Brevibacterium	flavum	21427							
Brevibacterium	flavum	21475							
Brevibacterium	flavum	21517							
Brevibacterium	flavum	21528							
Brevibacterium	flavum	21529							
Brevibacterium	flavum			B11477					
Brevibacterium	flavum			B11478					
Brevibacterium	flavum	21127							
Brevibacterium	flavum			B11474					
Brevibacterium	healii	15527							
Brevibacterium	ketoglutamicum	21004							
Brevibacterium	ketoglutamicum	21089							
Brevibacterium	ketosoreductum	21914							
Brevibacterium	lactofermentum				70				
Brevibacterium	lactofermentum				74				
Brevibacterium	lactofermentum				77				
Brevibacterium	lactofermentum	21798							
Brevibacterium	lactofermentum	21799							
Brevibacterium	lactofermentum	21800							
Brevibacterium	lactofermentum	21801							
Brevibacterium	lactofermentum			B11470					
Brevibacterium	lactofermentum			B11471					

Genus	Species	ATCC	FERM	NRRL	CECT	NCIMB	CBS	NCTC	DSMZ
Brevibacterium	lactofermentum	21086							
Brevibacterium	lactofermentum	21420							
Brevibacterium	lactofermentum	21086							
Brevibacterium	lactofermentum	31269							
Brevibacterium	linens	9174							
Brevibacterium	linens	19391							
Brevibacterium	linens	8377							
Brevibacterium	paraffinolyticum					11160			
Brevibacterium	spec.						717.73		
Brevibacterium	spec.						717.73		
Brevibacterium	spec.	14604							
Brevibacterium	spec.	21860							
Brevibacterium	spec.	21864							
Brevibacterium	spec.	21865							
Brevibacterium	spec.	21866							
Brevibacterium	spec.	19240							
Corynebacterium	acetoacidophilum	21476							
Corynebacterium	acetoacidophilum	13870							
Corynebacterium	acetoglutamicum			B11473					
Corynebacterium	acetoglutamicum			B11475					
Corynebacterium	acetoglutamicum	15806							
Corynebacterium	acetoglutamicum	21491							
Corynebacterium	acetoglutamicum	31270							
Corynebacterium	acetophilum			B3671					
Corynebacterium	ammoniagenes	6872						2399	
Corynebacterium	ammoniagenes	15511							
Corynebacterium	fujiokense	21496							
Corynebacterium	glutamicum	14067							
Corynebacterium	glutamicum	39137							
Corynebacterium	glutamicum	21254							
Corynebacterium	glutamicum	21255							
Corynebacterium	glutamicum	31830							
Corynebacterium	glutamicum	13032							
Corynebacterium	glutamicum	14305							
Corynebacterium	glutamicum	15455							
Corynebacterium	glutamicum	13058							
Corynebacterium	glutamicum	13059							
Corynebacterium	glutamicum	13060							
Corynebacterium	glutamicum	21492							
Corynebacterium	glutamicum	21513							
Corynebacterium	glutamicum	21526							
Corynebacterium	glutamicum	21543							
Corynebacterium	glutamicum	13287							
Corynebacterium	glutamicum	21851							
Corynebacterium	glutamicum	21253							
Corynebacterium	glutamicum	21514							
Corynebacterium	glutamicum	21516							
Corynebacterium	glutamicum	21299							

Genus	Species	ATCC	FERM	NRRL	CEGT	NCIMB	CBS	NCIC	DSMZ
Corynebacterium	glutamicum	21300							
Corynebacterium	glutamicum	39684							
Corynebacterium	glutamicum	21488							
Corynebacterium	glutamicum	21649							
Corynebacterium	glutamicum	21650							
Corynebacterium	glutamicum	19223							
Corynebacterium	glutamicum	13869							
Corynebacterium	glutamicum	21157							
Corynebacterium	glutamicum	21158							
Corynebacterium	glutamicum	21159							
Corynebacterium	glutamicum	21355							
Corynebacterium	glutamicum	31808							
Corynebacterium	glutamicum	21674							
Corynebacterium	glutamicum	21562							
Corynebacterium	glutamicum	21563							
Corynebacterium	glutamicum	21564							
Corynebacterium	glutamicum	21565							
Corynebacterium	glutamicum	21566							
Corynebacterium	glutamicum	21567							
Corynebacterium	glutamicum	21568							
Corynebacterium	glutamicum	21569							
Corynebacterium	glutamicum	21570							
Corynebacterium	glutamicum	21571							
Corynebacterium	glutamicum	21572							
Corynebacterium	glutamicum	21573							
Corynebacterium	glutamicum	21579							
Corynebacterium	glutamicum	19049							
Corynebacterium	glutamicum	19050							
Corynebacterium	glutamicum	19051							
Corynebacterium	glutamicum	19052							
Corynebacterium	glutamicum	19053							
Corynebacterium	glutamicum	19054							
Corynebacterium	glutamicum	19055							
Corynebacterium	glutamicum	19056							
Corynebacterium	glutamicum	19057							
Corynebacterium	glutamicum	19058							
Corynebacterium	glutamicum	19059							
Corynebacterium	glutamicum	19060							
Corynebacterium	glutamicum	19185							
Corynebacterium	glutamicum	13286							
Corynebacterium	glutamicum	21515							
Corynebacterium	glutamicum	21527							
Corynebacterium	glutamicum	21544							
Corynebacterium	glutamicum	21492							
Corynebacterium	glutamicum			B8183					
Corynebacterium	glutamicum			B8182					
Corynebacterium	glutamicum			B12416					
Corynebacterium	glutamicum			B12417					

Genus	species	ATCC	FERM	NRRL	CECT	NCIMB	CBS	NCTC	DSMZ
Corynebacterium	glutamicum			B12418					
Corynebacterium	glutamicum			B11476					
Corynebacterium	glutamicum	21608							
Corynebacterium	lilium		P973						
Corynebacterium	nitrilophilus	21419				11594			
Corynebacterium	spec.		P4445						
Corynebacterium	spec.		P4446						
Corynebacterium	spec.	31088							
Corynebacterium	spec.	31089							
Corynebacterium	spec.	31090							
Corynebacterium	spec.	31090							
Corynebacterium	spec.	31090							
Corynebacterium	spec.	15954							20145
Corynebacterium	spec.	21857							
Corynebacterium	spec.	21862							
Corynebacterium	spec.	21863							

ATCC: American Type Culture Collection, Rockville, MD, USA

FERM: Fermentation Research Institute, Chiba, Japan

NRRL: ARS Culture Collection, Northern Regional Research Laboratory, Peoria, IL, USA

CECT: Coleccion Espanola de Cultivos Tipo, Valencia, Spain

NCIMB: National Collection of Industrial and Marine Bacteria Ltd., Aberdeen, UK

CBS: Centraalbureau voor Schimmelcultures, Baarn, NL

NCTC: National Collection of Type Cultures, London, UK

DSMZ: Deutsche Sammlung von Mikroorganismen und Zellkulturen, Braunschweig, Germany

For reference see Sugawara, H. et al. (1993) World directory of collections of cultures of microorganisms: Bacteria, fungi and yeasts (4<sup>th</sup> edn), World federation for culture collections world data center on microorganisms, Saimata, Japan.



TABLE 4: ALIGNMENT RESULTS

ID #	length (NT)	Genbank Hit	Length	Accession	Name of Genbank Hit	Source of Genbank Hit	% homology (GAP)	Date of Deposit
ra00062	1521	GB_HTG2:AC007366	185001	AC007366	Homo sapiens clone NH0501G22, *** SEQUENCING IN PROGRESS *** , 3 unordered pieces.	Homo sapiens	39,080	5-Jun-99
ra00084	948	GB_PR3:HSU80741	912	U80741	Homo sapiens CAGH44 mRNA, partial cds.	Homo sapiens	39,264	18-DEC-1997
		GB_PL1:BNDNATRNA	1732	X89901	B.nigra DNA for tRNA like gene.	Brassica nigra	36,725	6-Feb-97
		GB_PR3:HSU80741	912	U80741	Homo sapiens CAGH44 mRNA, partial cds.	Homo sapiens	38,957	18-DEC-1997
ra00109	735	GB_GSS9:AQ163721	388	AQ163721	HS_2245_A1_F07_MF CIT Approved Human Genomic Sperm Library D Homo sapiens genomic clone Plate=2245 Col=13 Row=K, genomic survey sequence.	Homo sapiens	45,066	16-OCT-1998
		GB_HTG4:AC007054	171979	AC007054	Drosophila melanogaster chromosome 2 clone BACR45O18 (D527) RPCI-98 45.O.18 map 41E-41E strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 13 unordered pieces.	Drosophila melanogaster	36,589	13-OCT-1999
		GB_HTG4:AC007054	171979	AC007054	Drosophila melanogaster chromosome 2 clone BACR45O18 (D527) RPCI-98 45.O.18 map 41E-41E strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 13 unordered pieces.	Drosophila melanogaster	36,589	13-OCT-1999
ra00215	1449	GB_BA1:SC9C7	31360	AL035161	Streptomyces coelicolor cosmid 9C7.	Streptomyces coelicolor	44,444	12-Jan-99
		GB_BA1:SCE94	38532	AL049628	Streptomyces coelicolor cosmid E94.	Streptomyces coelicolor	36,313	12-Apr-99
		GB_BA2:AF110185	20302	AF110185	Burkholderia pseudomallei strain 1026b DbhB (dbhB), general secretory pathway protein D (gspD), general secretory pathway protein E (gspE), general secretory pathway protein F (gspF), GspC (gspC), general secretory pathway protein G {gspG}, general secretory pathway protein H (gspH), general secretory pathway protein I (gspI), general secretory pathway protein J (gspJ), general secretory pathway protein K (gspK), general secretory pathway protein L (gspL), general secretory pathway protein M (gspM), and general secretory pathway protein N (gspN) genes, complete cds; and unknown genes.	Burkholderia pseudomallei	44,159	2-Aug-99
ra00289	1299	GB_EST6:N80167	384	N80167	za65g02.s1 Soares fetal liver spleen 1NFLS Homo sapiens cDNA clone IMAGE:297458 3', mRNA sequence.	Homo sapiens	40,420	29-MAR-1996
		GB_STS:G37084	384	G37084	SHGC-56832 Human Homo sapiens STS genomic, sequence tagged site.	Homo sapiens	40,420	30-MAR-1998
		GB_STS:G37084	384	G37084	SHGC-56832 Human Homo sapiens STS genomic, sequence tagged site.	Homo sapiens	40,420	30-MAR-1998
ra00404	2439	GB_BA1:MTCY22D7	31859	Z83866	Mycobacterium tuberculosis H37Rv complete genome; segment 133/162.	Mycobacterium tuberculosis	60,271	17-Jun-98
		GB_BA1:ECU82598	136742	U82598	Escherichia coli genomic sequence of minutes 9 to 12.	Escherichia coli	54,256	15-Jan-97
		GB_BA2:AE000165	12003	AE000165	Escherichia coli K-12 MG1655 section 55 of 400 of the complete genome.	Escherichia coli	54,256	12-Nov-98
ra00479	2313	GB_BA1:SCF43A	35437	AL096837	Streptomyces coelicolor cosmid F43A.	Streptomyces coelicolor A3(2)	36,245	13-Jul-99
		GB_GSS2:CNS015U4	1036	AL105910	Drosophila melanogaster genome survey sequence SP6 end of BAC BACN14G08 of DrosBAC library from Drosophila melanogaster (fruit fly), genomic survey sequence.	Drosophila melanogaster	37,573	26-Jul-99

**Table 4 (continued)**

WO 01/00804									PCT/IB00/00922
rxa00497	420	GB_PR3:HSA494O16	50502	AL117328	Human DNA sequence from clone 494O16 on chromosome 22, complete sequence.	Homo sapiens	36,475	23-Nov-99	
		GB_BA1:MTCY78	33818	Z77165	Mycobacterium tuberculosis H37Rv complete genome; segment 145/162.	Mycobacterium tuberculosis	40,250	17-Jun-98	
		GB_BA2:AF079544	817	AF079544	Mycobacterium avium GroESL operon, partial sequence.	Mycobacterium avium	64,439	16-Aug-98	
		GB_BA1:MTGROEOP	2987	X60350	M.tuberculosis groE gene for KCS and 10-kDa products.	Mycobacterium tuberculosis	62,857	23-Apr-92	
rxa00575									
rxa00599	510	GB_GSS10:AQ199703	439	AQ199703	RPC111-46O13.TJ RPC11-11 Homo sapiens genomic clone RPC11-11-46O13, genomic survey sequence.	Homo sapiens	42,657	20-Apr-99	
		GB_PR2:AC002127	144165	AC002127	Human BAC clone RG305H12 from 7q21, complete sequence.	Homo sapiens	37,052	27-MAY-1997	
rxa00600	1221	GB_STS:G51234	439	G51234	SHGC-80708 Human Homo sapiens STS genomic, sequence tagged site.	Homo sapiens	42,657	25-Jun-99	
		GB_BA1:MTCY441	35187	Z80225	Mycobacterium tuberculosis H37Rv complete genome; segment 118/162.	Mycobacterium tuberculosis	56,183	18-Jun-98	
		GB_BA1:MSGY223	42061	AD000019	Mycobacterium tuberculosis sequence from clone y223.	Mycobacterium tuberculosis	37,217	10-DEC-1996	
rxa00605	1603	GB_BA1:BSUB0014	213420	Z99117	Bacillus subtilis complete genome (section 14 of 21): from 2599451 to 2812870.	Bacillus subtilis	36,553	26-Nov-97	
		GB_BA2:AF069070	2776	AF069070	Endosymbiont of Onchocerca volvulus catalase gene, complete cds.	endosymbiont of Onchocerca volvulus	55,396	25-Nov-98	
		GB_BA1:OVCAT	1845	X82176	Onchocerca volvulus endobacterial mRNA for catalase.	endosymbiont of Onchocerca volvulus	55,396	26-Nov-98	
		GB_BA1:SC2G5	38404	AL035478	Streptomyces coelicolor cosmid 2G5.	Streptomyces coelicolor	39,530	11-Jun-99	
rxa00648	1533	GB_HTG1:HS74O16	169401	AL110119	Homo sapiens chromosome 21 clone RPCIP704O1674 map 21q21, *** SEQUENCING IN PROGRESS ***; in unordered pieces.	Homo sapiens	36,327	27-Aug-99	
		GB_HTG1:HS74O16	169401	AL110119	Homo sapiens chromosome 21 clone RPCIP704O1674 map 21q21, *** SEQUENCING IN PROGRESS ***; in unordered pieces.	Homo sapiens	36,327	27-Aug-99 <sup>1</sup>	
		GB_HTG1:HS74O16	169401	AL110119	Homo sapiens chromosome 21 clone RPCIP704O1674 map 21q21, *** SEQUENCING IN PROGRESS ***; in unordered pieces.	Homo sapiens	35,119	27-Aug-99	
rxa00764	1239	GB_EST36:AI898007	609	AI898007	EST267450 tomato ovary, TAMU Lycopersicon esculentum cDNA clone cLED31K22, mRNA sequence.	Lycopersicon esculentum	34,323	27-Jul-99	
rxa00803	1353	GB_BA2:PAU93274	8008	U93274	Pseudomonas aeruginosa YafE (yafE), LeuB (leuB), Asd (asd), FimV (fimV), and HisT (hisT) genes, complete cds; TrpF (trpF) gene, partial cds; and unknown	Pseudomonas aeruginosa	35,895	23-Jun-98	
		GB_BA2:PAU93274	8008	U93274	Pseudomonas aeruginosa YafE (yafE), LeuB (leuB), Asd (asd), FimV (fimV), and HisT (hisT) genes, complete cds; TrpF (trpF) gene, partial cds; and unknown	Pseudomonas aeruginosa	41,417	23-Jun-98	
		GB_IN2:CELH34C03	27748	AF100662	Caenorhabditis elegans cosmid H34C03.	Caenorhabditis elegans	34,152	28-OCT-1998	
		GB_HTG2:AC007905	100722	AC007905	Homo sapiens chromosome 16q24.3 clone PAC 754F23, *** SEQUENCING IN PROGRESS ***; 33 unordered pieces.	Homo sapiens	37,472	24-Jun-99	
		GB_HTG2:AC007905	100722	AC007905	Homo sapiens chromosome 16q24.3 clone PAC 754F23, *** SEQUENCING IN PROGRESS ***; 33 unordered pieces.	Homo sapiens	37,472	24-Jun-99	

Table 4 (continued)

rx00810 324	GB_BA1:MTY15C10	33050	Z95436	Mycobacterium tuberculosis H37Rv complete genome; segment 154/162.	Mycobacterium tuberculosis	34,615	17-Jun-98
rx00829 2463	GB_BA1:MLCB2548	38916	AL023093	Mycobacterium leprae cosmid B2548.	Mycobacterium leprae	34,615	27-Aug-99
	GB_BA1:ECOUW76	225419	U00039	E. coli chromosomal region from 76.0 to 81.5 minutes.	Escherichia coli	52,997	7-Nov-96
	GB_BA1:SC5C7	41906	AL031515	Streptomyces coelicolor cosmid 5C7.	Streptomyces coelicolor	65,269	7-Sep-98
	GB_BA1:SC5F2A	40105	AL049587	Streptomyces coelicolor cosmid 5F2A.	Streptomyces coelicolor	37,490	24-MAY-1999
rx00843 468	GB_BA1:STMDRRRC	3374	L76359	Streptomyces peucetius daunorubicin resistance protein (drrC) gene, complete	Streptomyces peucetius	55,279	24-DEC-1996
	GB_BA1:MTCY9C4	15916	Z77250	Mycobacterium tuberculosis H37Rv complete genome; segment 113/162.	Mycobacterium tuberculosis	40,000	17-Jun-98
	GB_BA1:MTCY9C4	15916	Z77250	Mycobacterium tuberculosis H37Rv complete genome; segment 113/162.	Mycobacterium tuberculosis	37,773	17-Jun-98
rx00858 568	GB_BA1:SCC54	30753	AL035591	Streptomyces coelicolor cosmid C54.	Streptomyces coelicolor	39,602	11-Jun-99
	GB_EST18:N96610	547	N96610	21285 Lambda-PRL1 Arabidopsis thaliana cDNA clone F10G3T7, mRNA	Arabidopsis thaliana	37,801	5-Jan-98
	GB_EST18:T45493	436	T45493	8756 Lambda-PRL2 Arabidopsis thaliana cDNA clone 133C14T7, mRNA	Arabidopsis thaliana	34,194	4-Aug-98
	GB_BA1:SYCSLLH	132106	D64006	Synechocystis sp. PCC6803 complete genome, 25/27, 3138604-3270709.	Synechocystis sp.	37,459	13-Feb-99
	GB_BA1:SCDNAJ	5611	X77458	S.coelicolor dnaK, grpE and dnaJ genes.	Streptomyces coelicolor	49,744	21-Nov-96
rx00900 975	GB_BA1:STMDNAK	4648	L46700	Streptomyces coelicolor (strain A3(2)) dnaK operon encoding molecular chaperones (dnaK, dnaJ), grpE and hspR genes, complete cds's.	Streptomyces coelicolor	49,583	22-Nov-96
	GB_BA2:ECOUW67_0	110000	U18997	Escherichia coli K-12 chromosomal region from 67.4 to 76.0 minutes.	Escherichia coli	38,314	U18997
	GB_BA2:ECOUW67_0	110000	U18997	Escherichia coli K-12 chromosomal region from 67.4 to 76.0 minutes.	Escherichia coli	37,759	U18997
	GB_BA2:AE000393	10516	AE000393	Escherichia coli K-12 MG1655 section 283 of 400 of the complete genome.	Escherichia coli	38,314	12-Nov-98
	GB_HTG3:AC010757	175571	AC010757	Homo sapiens chromosome 18 clone 128_C_18 map 18, *** SEQUENCING IN PROGRESS ***, 20 unordered pieces.	Homo sapiens	34,857	22-Sep-99
rx00981 753	GB_HTG3:AC010757	175571	AC010757	Homo sapiens chromosome 18 clone 128_C_18 map 18, *** SEQUENCING IN PROGRESS ***, 20 unordered pieces.	Homo sapiens	34,857	22-Sep-99
	GB_HTG3:AC011283	87295	AC011283	Homo sapiens clone MS2016A09, *** SEQUENCING IN PROGRESS ***, 1 unordered pieces.	Homo sapiens	35,448	07-OCT-1999
	GB_OV:GGA245664	512	AJ245664	Gallus gallus partial mRNA for ATP-citrate lyase (ACL gene).	Gallus gallus	37,538	28-Sep-99
rx00995 864	GB_PL2:AC007887	159434	AC007887	Genomic sequence for Arabidopsis thaliana BAC F15O4 from chromosome 1, complete sequence.	Arabidopsis thaliana	37,600	04-OCT-1999
	GB_GSS1:CNS00RNW542	AL087338	AL087338	Arabidopsis thaliana genome survey sequence T7 end of BAC F14D7 of IGF library from strain Columbia of Arabidopsis thaliana, genomic survey sequence.	Arabidopsis thaliana	41,264	28-Jun-99
	GB_EST29:AI553951	450	AI553951	te54d01.x1 Soares_NFL_T_GBC_S1 Homo sapiens cDNA clone IMAGE:2090497 3' similar to gb:X02067 H.sapiens mRNA for 7SL RNA pseudogene (HUMAN); mRNA sequence.	Homo sapiens	42,627	13-Apr-99
rx00996 864	GB_PR3:AC003029	139166	AC003029	Homo sapiens Chromosome 12q24 PAC RPC13-462E2 (Roswell Park Cancer Institute Human PAC library) complete sequence.	Homo sapiens	38,915	17-Sep-98
	GB_BA1:EAY14603	4479	Y14603	Erwinia amylovora srlA, srlE, srlB, srlD, srlM and srlR genes.	Erwinia amylovora	37,694	6-Jan-98
	GB_BA2:AE001001	10730	AE001001	Archaeoglobus fulgidus section 106 of 172 of the complete genome.	Archaeoglobus fulgidus	41,078	15-DEC-1997
	GB_EST30:AV018764	242	AV018764	AV018764 Mus musculus 18-day embryo C57BL/6J Mus musculus cDNA clone 1190006M16, mRNA sequence.	Mus musculus	39,669	28-Aug-99





Table 4(continued)

rxa01408 324	GB_HTG3:AC010831	70233	AC010831	Homo sapiens clone 6_L_24, LOW-PASS SEQUENCE SAMPLING.	Homo sapiens	35,764	23-Sep-99
	GB_PR3:AC004058	38400	AC004058	Homo sapiens chromosome 4 clone B241P19 map 4q25, complete sequence.	Homo sapiens	40,778	30-Sep-98
	GB_PR4:AF152365	246546	AF152365	Homo sapiens constitutive fragile region FRA3B sequence.	Homo sapiens	41,234	1-Aug-99
	GB_HTG3:AC007890	121256	AC007890	Drosophila melanogaster chromosome 3 clone BACR02G21 (D722) RPCI-98 02.G.21 map 90E-91A strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 89 unordered pieces.	Drosophila melanogaster	39,432	3-Sep-99
rxa01524 1566	GB_HTG3:AC007890	121256	AC007890	Drosophila melanogaster chromosome 3 clone BACR02G21 (D722) RPCI-98 02.G.21 map 90E-91A strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 89 unordered pieces.	Drosophila melanogaster	39,432	3-Sep-99
	GB_BA1:BSUB0015	218410	Z99118	Bacillus subtilis complete genome (section 15 of 21): from 2795131 to 3013540.	Bacillus subtilis	38,201	26-Nov-97
	GB_HTG2:AC008260	107439	AC008260	Drosophila melanogaster chromosome 2 clone BACR13J10 (D924) RPCI-98 13.J.10 map 47B-47C strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 82 unordered pieces.	Drosophila melanogaster	38,302	2-Aug-99
	GB_HTG2:AC008260	107439	AC008260	Drosophila melanogaster chromosome 2 clone BACR13J10 (D924) RPCI-98 13.J.10 map 47B-47C strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 82 unordered pieces.	Drosophila melanogaster	38,302	2-Aug-99
rxa01578 1510	GB_PR4:AF111170	148083	AF111170	Homo sapiens 14q32 Jagged2 gene, complete cds; and unknown gene.	Homo sapiens	37,873	14-Jul-99
	GB_PR4:AF111170	148083	AF111170	Homo sapiens 14q32 Jagged2 gene, complete cds; and unknown gene.	Homo sapiens	40,220	14-Jul-99
	GB_BA1:AEY13732	6740	Y13732	Alcaligenes eutrophus genes for ureases, ureD1, ureD2, ureA, ureB, and ORF1, ORF2.	Ralstonia eutropha	42,960	23-Sep-97
	GB_BA2:AF088857	2908	AF088857	Vogesella indigofera indigoidine biosynthesis regulatory locus, complete Caenorhabditis elegans cosmid M04D8, complete sequence.	Vogesella indigofera Caenorhabditis elegans	37,626 37,237	10-Sep-99 23-Nov-98
rxa01616 1605	GB_EST25:AI281910	276	AI281910	qi82d04.x1 NCI_CGAP_Co14 Homo sapiens cDNA clone IMAGE:1961767 3', mRNA sequence.	Homo sapiens	38,406	21-DEC-1998
	GB_BA1:CGU43535	2531	U43535	Corynebacterium glutamicum multidrug resistance protein (cmr) gene, complete cds.	Corynebacterium glutamicum	99,933	9-Apr-97
	GB_HTG3:AC009213	114735	AC009213	Drosophila melanogaster chromosome 3 clone BACR09F18 (D812) RPCI-98 09.F.18 map 98D-98D strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 109 unordered pieces.	Drosophila melanogaster	36,111	23-Aug-99
	GB_HTG3:AC009213	114735	AC009213	Drosophila melanogaster chromosome 3 clone BACR09F18 (D812) RPCI-98 09.F.18 map 98D-98D strain y; cn bw sp, *** SEQUENCING IN PROGRESS***, 109 unordered pieces.	Drosophila melanogaster	36,111	23-Aug-99
rxa01674 1017	GB_PL1:AB017159	1859	AB017159	Daucus carota mRNA for citrate synthase, complete cds.	Daucus carota	39,537	01-MAY-1999
	GB_PR1:HUMGNOS4823142	D26607	D26607	Homo sapiens endothelial nitric oxide synthase gene, complete cds.	Homo sapiens	36,419	13-Jul-99
	GB_HTG3:AC011234	154754	AC011234	Homo sapiens clone NH0166D23, *** SEQUENCING IN PROGRESS***, 7 unordered pieces.	Homo sapiens	36,317	04-OCT-1999
	GB_HTG3:AC009450	124337	AC009450	Homo sapiens chromosome 9 clone 30_C_23 map 9, *** SEQUENCING IN PROGRESS***, 20 unordered pieces.	Homo sapiens	35,303	22-Aug-99
rxa01873 1359	GB_HTG3:AC009450	124337	AC009450	Homo sapiens chromosome 9 clone 30_C_23 map 9, *** SEQUENCING IN PROGRESS***, 20 unordered pieces.	Homo sapiens	35,303	22-Aug-99
	GB_HTG3:AC009919	134724	AC009919	Homo sapiens clone 115_I_23, LOW-PASS SEQUENCE SAMPLING. E.coli protein p7 (neu C) gene, complete cds.	Homo sapiens Escherichia coli	35,409 35,189	8-Sep-99 26-Apr-93
	GB_BA1:ECONUC	1676	M84026				



Table 4 (continued)

	GB_HTG2:AC007853	116280	AC007853	Drosophila melanogaster chromosome 3 clone BACR03L02 (D766) RPCI-98 03.L.2 map 96B-96C strain y; cn bw sp, *** SEQUENCING IN PROGRESS *** , 80 unordered pieces.	Drosophila melanogaster	34,365	2-Aug-99
	GB_HTG2:AC007853	116280	AC007853	Drosophila melanogaster chromosome 3 clone BACR03L02 (D766) RPCI-98 03.L.2 map 96B-96C strain y; cn bw sp, *** SEQUENCING IN PROGRESS*** , 80 unordered pieces.	Drosophila melanogaster	34,365	2-Aug-99
rxa01936	GB_HTG4:AC010037	166249	AC010037	Drosophila melanogaster chromosome 3L/66B6 clone RPCI98-6E4, *** SEQUENCING IN PROGRESS *** , 52 unordered pieces.	Drosophila melanogaster	38,534	16-OCT-1999
	GB_HTG4:AC010037	166249	AC010037	Drosophila melanogaster chromosome 3L/66B6 clone RPCI98-6E4, *** SEQUENCING IN PROGRESS *** , 52 unordered pieces.	Drosophila melanogaster	38,534	16-OCT-1999
rxa01984	GB_PR4:AC005552	167228	AC005552	Homo sapiens chromosome 17, clone hRPK.212_E_8, complete sequence.	Homo sapiens	36,249	26-Nov-98
	GB_PR1:HS169C8F	245	Z57239	H.sapiens CpG island DNA genomic Mse1 fragment, clone 169c8, forward read cpg169c8.fl1a.	Homo sapiens	45,679	18-OCT-1995
	GB_BA1:SERATTBXIS	3255	L11597	Saccharopolyspora erythraea excisionase (xis) gene, integrase (int) gene, complete cds's and attB site.	Saccharopolyspora erythraea	36,232	6-Jul-94
	GB_EST7:W97557	267	W97557	mf98a09.r1 Soares mouse embryo NbME13.5 14.5 Mus musculus cDNA clone IMAGE:422296 5', mRNA sequence.	Mus musculus	42,969	16-Jul-96
rxa02060							
rxa02087	GB_PR3:AC005544	169045	AC005544	Homo sapiens chromosome 17, clone hRPK.349_A_8, complete sequence.	Homo sapiens	35,724	25-Sep-98
	GB_PL1:ATF20B18	104738	AL049483	Arabidopsis thaliana DNA chromosome 4, BAC clone F20B18 (ESSA project).	Arabidopsis thaliana	35,890	24-MAR-1999
rxa02088	GB_PL2:ATT25K17	89904	AL049171	Arabidopsis thaliana DNA chromosome 4, BAC clone (ESSA project).	Arabidopsis thaliana	38,128	27-Aug-99
	GB_HTG3:AC008697	167932	AC008697	Homo sapiens chromosome 5 clone CIT978SKB_70D3, *** SEQUENCING IN PROGRESS *** , 54 unordered pieces.	Homo sapiens	36,662	3-Aug-99
	GB_HTG3:AC008697	167932	AC008697	Homo sapiens chromosome 5 clone CIT978SKB_70D3, *** SEQUENCING IN PROGRESS *** , 54 unordered pieces.	Homo sapiens	36,662	3-Aug-99
	GB_HTG3:AC008703	213971	AC008703	Homo sapiens chromosome 5 clone CIT978SKB_76P12, *** SEQUENCING IN PROGRESS *** , 54 unordered pieces.	Homo sapiens	34,768	3-Aug-99
rxa02159	GB_BA2:AF049897	9196	AF049897	Corynebacterium glutamicum N-acetylglutamylphosphate reductase (argC), ornithine acetyltransferase (argJ), N-acetylglutamate kinase (argB), acetylornithine transaminase (argD), ornithine carbamoyltransferase (argF), arginine repressor (argR), argininosuccinate synthase (argG), and argininosuccinate lyase (argH) genes, complete cds.	Corynebacterium glutamicum	99,843	1-Jul-98
	GB_BA2:AF031518	2045	AF031518	Corynebacterium glutamicum ornithine carbamoyltransferase (argF) gene, complete cds.	Corynebacterium glutamicum	88,679	5-Jan-99
	GB_BA2:AF041436	516	AF041436	Corynebacterium glutamicum arginine repressor (argR) gene, complete cds.	Corynebacterium glutamicum	100,000	5-Jan-99
rxa02184	GB_BA1:BSZ92953	8164	Z92953	B.subtilis yws[A,B,C] genes and rbs[A,C,D,K,R] genes.	Bacillus subtilis	38,951	24-Jun-98
	GB_EST36:A1878071	593	A1878071	fc57a12.y1 Zebrafish WashU MPIMG EST Danio rerio cDNA 5' similar to TR:Q13151 Q13151 HETEROGENEOUS NUCLEAR RIBONUCLEOPROTEIN A0 ;, mRNA sequence.	Danio rerio	36,774	21-Jul-99



Table 4 (continued)

rxa02542 777	EM_PAT:E10832	1856	E10832	DNA encoding Dnak protein which is one of heat shock protein from	Corynebacterium glutamicum	99,000	08-OCT-1997 (Rel. 52, Created)
rxs03217 331	GB_EST24:Z82017	396	Z82017	SSZ82017 Porcine small intestine cDNA library Sus scrofa cDNA clone c12c06 5' similar to eukaryotic initiation factor 4 gamma, mRNA sequence.	Sus scrofa	37,067	30-Apr-99
	GB_OM:CATERYTHRO681		L10606	Cat erythropoietin mRNA, 3' end.	Felis catus	39,409	14-OCT-1993
	EM_PAT:E10832	1856	E10832	DNA encoding Dnak protein which is one of heat shock protein from	Corynebacterium glutamicum	97,306	08-OCT-1997 (Rel. 52, Created)
rxs03217 331	GB_BA1:MPHSP70	2179	X59437	M.paratuberculosis gene for 70 kD heat shock protein.	Mycobacterium avium subsp. paratuberculosis	73,404	23-Apr-92
	GB_BA1:MTY13E10	35019	Z95324	Mycobacterium tuberculosis H37Rv complete genome; segment 18/162.	Mycobacterium tuberculosis	72,028	17-Jun-98
	GB_IN2:AC006472	156362	AC006472	Drosophila melanogaster, chromosome 2R, region 45E1-46A2, BAC clone BACR48G21, complete sequence.	Drosophila melanogaster	37,958	30-Jan-99
rxs03217 331	GB_HTG4:AC010020	106541	AC010020	Drosophila melanogaster chromosome 3L/66D10 clone RPCI98-2613, *** SEQUENCING IN PROGRESS ***, 55 unordered pieces.	Drosophila melanogaster	37,333	16-OCT-1999
	GB_HTG4:AC010020	106541	AC010020	Drosophila melanogaster chromosome 3L/66D10 clone RPCI98-2613, *** SEQUENCING IN PROGRESS ***, 55 unordered pieces.	Drosophila melanogaster	37,333	16-OCT-1999
	GB_BA1:MLCL622	42498	Z95398	Mycobacterium leprae cosmid L622.	Mycobacterium leprae	39,848	24-Jun-97
rxs03217 331	GB_RO:AF074879	3316	AF074879	Rattus norvegicus testis-specific protein TSPY gene, complete cds.	Rattus norvegicus	35,830	6-Jul-99
	GB_RO:RNJ001380	2641	AJ001380	Rattus norvegicus Tspy partial genomic sequence, exons 1-6.	Rattus norvegicus	37,702	29-Jun-98
	GB_BA1:MLCB2548	38916	AL023093	Mycobacterium leprae cosmid B2548.	Mycobacterium leprae	37,888	27-Aug-99
rxs03217 331	GB_HTG2:HSJ662M14	174772	AL079336	Homo sapiens chromosome 20 clone RP4-662M14, *** SEQUENCING IN PROGRESS ***, 10 unordered pieces.	Homo sapiens	36,420	4-Feb-00
	GB_HTG2:HSJ662M14	174772	AL079336	Homo sapiens chromosome 20 clone RP4-662M14, *** SEQUENCING IN PROGRESS ***, 10 unordered pieces.	Homo sapiens	35,962	4-Feb-00

### Exemplification

#### **Example 1: Preparation of total genomic DNA of *Corynebacterium glutamicum* ATCC 13032**

5           A culture of *Corynebacterium glutamicum* (ATCC 13032) was grown overnight at 30°C with vigorous shaking in BHI medium (Difco). The cells were harvested by centrifugation, the supernatant was discarded and the cells were resuspended in 5 ml buffer-I (5% of the original volume of the culture — all indicated volumes have been calculated for 100 ml of culture volume). Composition of buffer-I: 140.34 g/l sucrose,  
10   2.46 g/l  $\text{MgSO}_4 \times 7\text{H}_2\text{O}$ , 10 ml/l  $\text{KH}_2\text{PO}_4$  solution (100 g/l, adjusted to pH 6.7 with KOH), 50 ml/l M12 concentrate (10 g/l  $(\text{NH}_4)_2\text{SO}_4$ , 1 g/l NaCl, 2 g/l  $\text{MgSO}_4 \times 7\text{H}_2\text{O}$ , 0.2 g/l  $\text{CaCl}_2$ , 0.5 g/l yeast extract (Difco), 10 ml/l trace-elements-mix (200 mg/l  $\text{FeSO}_4 \times \text{H}_2\text{O}$ , 10 mg/l  $\text{ZnSO}_4 \times 7 \text{H}_2\text{O}$ , 3 mg/l  $\text{MnCl}_2 \times 4 \text{H}_2\text{O}$ , 30 mg/l  $\text{H}_3\text{BO}_3$ , 20 mg/l  $\text{CoCl}_2 \times 6 \text{H}_2\text{O}$ , 1 mg/l  $\text{NiCl}_2 \times 6 \text{H}_2\text{O}$ , 3 mg/l  $\text{Na}_2\text{MoO}_4 \times 2 \text{H}_2\text{O}$ , 500 mg/l complexing agent  
15 (EDTA or citric acid), 100 ml/l vitamins-mix (0.2 mg/l biotin, 0.2 mg/l folic acid, 20 mg/l p-amino benzoic acid, 20 mg/l riboflavin, 40 mg/l ca-panthothenate, 140 mg/l nicotinic acid, 40 mg/l pyridoxole hydrochloride, 200 mg/l myo-inositol). Lysozyme was added to the suspension to a final concentration of 2.5 mg/ml. After an approximately 4 h incubation at 37°C, the cell wall was degraded and the resulting  
20 protoplasts are harvested by centrifugation. The pellet was washed once with 5 ml buffer-I and once with 5 ml TE-buffer (10 mM Tris-HCl, 1 mM EDTA, pH 8). The pellet was resuspended in 4 ml TE-buffer and 0.5 ml SDS solution (10%) and 0.5 ml NaCl solution (5 M) are added. After adding of proteinase K to a final concentration of 200 µg/ml, the suspension is incubated for ca.18 h at 37°C. The DNA was purified by  
25 extraction with phenol, phenol-chloroform-isoamylalcohol and chloroform-isoamylalcohol using standard procedures. Then, the DNA was precipitated by adding 1/50 volume of 3 M sodium acetate and 2 volumes of ethanol, followed by a 30 min incubation at -20°C and a 30 min centrifugation at 12,000 rpm in a high speed centrifuge using a SS34 rotor (Sorvall). The DNA was dissolved in 1 ml TE-buffer containing 20  
30 µg/ml RNaseA and dialysed at 4°C against 1000 ml TE-buffer for at least 3 hours. During this time, the buffer was exchanged 3 times. To aliquots of 0.4 ml of the dialysed DNA solution, 0.4 ml of 2 M LiCl and 0.8 ml of ethanol are added. After a 30

min incubation at -20°C, the DNA was collected by centrifugation (13,000 rpm, Biofuge Fresco, Heraeus, Hanau, Germany). The DNA pellet was dissolved in TE-buffer. DNA prepared by this procedure could be used for all purposes, including southern blotting or construction of genomic libraries.

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**Example 2: Construction of genomic libraries in *Escherichia coli* of *Corynebacterium glutamicum* ATCC13032.**

Using DNA prepared as described in Example 1, cosmid and plasmid libraries were constructed according to known and well established methods (*see e.g.*, Sambrook, J. *et al.* (1989) "Molecular Cloning : A Laboratory Manual", Cold Spring Harbor Laboratory Press, or Ausubel, F.M. *et al.* (1994) "Current Protocols in Molecular Biology", John Wiley & Sons.)

Any plasmid or cosmid could be used. Of particular use were the plasmids pBR322 (Sutcliffe, J.G. (1979) *Proc. Natl. Acad. Sci. USA*, 75:3737-3741); pACYC177 (Change & Cohen (1978) *J. Bacteriol* 134:1141-1156), plasmids of the pBS series (pBSSK+, pBSSK- and others; Stratagene, LaJolla, USA), or cosmids as SuperCos1 (Stratagene, LaJolla, USA) or Lorist6 (Gibson, T.J., Rosenthal A. and Waterson, R.H. (1987) *Gene* 53:283-286. Gene libraries specifically for use in *C. glutamicum* may be constructed using plasmid pSL109 (Lee, H.-S. and A. J. Sinskey (1994) *J. Microbiol. Biotechnol.* 4: 256-263).

20

**Example 3: DNA Sequencing and Computational Functional Analysis**

Genomic libraries as described in Example 2 were used for DNA sequencing according to standard methods, in particular by the chain termination method using ABI377 sequencing machines (*see e.g.*, Fleischman, R.D. *et al.* (1995) "Whole-genome Random Sequencing and Assembly of Haemophilus Influenzae Rd., *Science*, 269:496-512). Sequencing primers with the following nucleotide sequences were used: 5'-GGAAACAGTATGACCATG-3' or 5'-GTAAAACGACGGCCAGT-3'.

25

**Example 4: *In vivo* Mutagenesis**

*In vivo* mutagenesis of *Corynebacterium glutamicum* can be performed by passage of plasmid (or other vector) DNA through *E. coli* or other microorganisms (*e.g.* *Bacillus* spp. or yeasts such as *Saccharomyces cerevisiae*) which are impaired in their capabilities to maintain

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the integrity of their genetic information. Typical mutator strains have mutations in the genes for the DNA repair system (e.g., mutHLS, mutD, mutT, etc.; for reference, see Rupp, W.D. (1996) DNA repair mechanisms, in: *Escherichia coli* and *Salmonella*, p. 2277-2294, ASM: Washington.) Such strains are well known to those of ordinary skill in the art. The use of such strains is illustrated, for example, in Greener, A. and Callahan, M. (1994) *Strategies* 7: 32-34.

**Example 5: DNA Transfer Between *Escherichia coli* and *Corynebacterium glutamicum***

Several *Corynebacterium* and *Brevibacterium* species contain endogenous plasmids (as e.g., pHM1519 or pBL1) which replicate autonomously (for review see, e.g., Martin, J.F. et al. (1987) *Biotechnology*, 5:137-146). Shuttle vectors for *Escherichia coli* and *Corynebacterium glutamicum* can be readily constructed by using standard vectors for *E. coli* (Sambrook, J. et al. (1989), "Molecular Cloning: A Laboratory Manual", Cold Spring Harbor Laboratory Press or Ausubel, F.M. et al. (1994) "Current Protocols in Molecular Biology", John Wiley & Sons) to which a origin or replication for and a suitable marker from *Corynebacterium glutamicum* is added. Such origins of replication are preferably taken from endogenous plasmids isolated from *Corynebacterium* and *Brevibacterium* species. Of particular use as transformation markers for these species are genes for kanamycin resistance (such as those derived from the Tn5 or Tn903 transposons) or chloramphenicol (Winnacker, E.L. (1987) "From Genes to Clones — Introduction to Gene Technology, VCH, Weinheim). There are numerous examples in the literature of the construction of a wide variety of shuttle vectors which replicate in both *E. coli* and *C. glutamicum*, and which can be used for several purposes, including gene over-expression (for reference, see e.g., Yoshihama, M. et al. (1985) *J. Bacteriol.* 162:591-597, Martin J.F. et al. (1987) *Biotechnology*, 5:137-146 and Eikmanns, B.J. et al. (1991) *Gene*, 102:93-98).

Using standard methods, it is possible to clone a gene of interest into one of the shuttle vectors described above and to introduce such a hybrid vector into strains of *Corynebacterium glutamicum*. Transformation of *C. glutamicum* can be achieved by protoplast transformation (Kastsumata, R. et al. (1984) *J. Bacteriol.* 159:306-311), electroporation (Liebl, E. et al. (1989) *FEMS Microbiol. Letters*, 53:399-303) and in cases where special vectors are used, also by conjugation (as described e.g. in Schäfer, A et al.

(1990) *J. Bacteriol.* 172:1663-1666). It is also possible to transfer the shuttle vectors for *C. glutamicum* to *E. coli* by preparing plasmid DNA from *C. glutamicum* (using standard methods well-known in the art) and transforming it into *E. coli*. This transformation step can be performed using standard methods, but it is advantageous to use an *Mcr*-deficient  
5 *E. coli* strain, such as NM522 (Gough & Murray (1983) *J. Mol. Biol.* 166:1-19).

Genes may be overexpressed in *C. glutamicum* strains using plasmids which comprise pCG1 (U.S. Patent No. 4,617,267) or fragments thereof, and optionally the gene for kanamycin resistance from TN903 (Grindley, N.D. and Joyce, C.M. (1980) *Proc. Natl. Acad. Sci. USA* 77(12): 7176-7180). In addition, genes may be  
10 overexpressed in *C. glutamicum* strains using plasmid pSL109 (Lee, H.-S. and A. J. Sinskey (1994) *J. Microbiol. Biotechnol.* 4: 256-263).

Aside from the use of replicative plasmids, gene overexpression can also be achieved by integration into the genome. Genomic integration in *C. glutamicum* or other *Corynebacterium* or *Brevibacterium* species may be accomplished by well-known  
15 methods, such as homologous recombination with genomic region(s), restriction endonuclease mediated integration (REMI) (see, *e.g.*, DE Patent 19823834), or through the use of transposons. It is also possible to modulate the activity of a gene of interest by modifying the regulatory regions (*e.g.*, a promoter, a repressor, and/or an enhancer) by sequence modification, insertion, or deletion using site-directed methods (such as  
20 homologous recombination) or methods based on random events (such as transposon mutagenesis or REMI). Nucleic acid sequences which function as transcriptional terminators may also be inserted 3' to the coding region of one or more genes of the invention; such terminators are well-known in the art and are described, for example, in Winnacker, E.L. (1987) *From Genes to Clones – Introduction to Gene Technology*. VCH:  
25 Weinheim.

#### **Example 6: Assessment of the Expression of the Mutant Protein**

Observations of the activity of a mutated protein in a transformed host cell rely on the fact that the mutant protein is expressed in a similar fashion and in a similar quantity  
30 to that of the wild-type protein. A useful method to ascertain the level of transcription of the mutant gene (an indicator of the amount of mRNA available for translation to the gene product) is to perform a Northern blot (for reference see, for example, Ausubel *et al.*

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(1988) Current Protocols in Molecular Biology, Wiley: New York), in which a primer designed to bind to the gene of interest is labeled with a detectable tag (usually radioactive or chemiluminescent), such that when the total RNA of a culture of the organism is extracted, run on gel, transferred to a stable matrix and incubated with this probe, the binding and quantity of binding of the probe indicates the presence and also the quantity of mRNA for this gene. This information is evidence of the degree of transcription of the mutant gene. Total cellular RNA can be prepared from *Corynebacterium glutamicum* by several methods, all well-known in the art, such as that described in Bormann, E.R. *et al.* (1992) *Mol. Microbiol.* 6: 317-326.

To assess the presence or relative quantity of protein translated from this mRNA, standard techniques, such as a Western blot, may be employed (see, for example, Ausubel *et al.* (1988) Current Protocols in Molecular Biology, Wiley: New York). In this process, total cellular proteins are extracted, separated by gel electrophoresis, transferred to a matrix such as nitrocellulose, and incubated with a probe, such as an antibody, which specifically binds to the desired protein. This probe is generally tagged with a chemiluminescent or colorimetric label which may be readily detected. The presence and quantity of label observed indicates the presence and quantity of the desired mutant protein present in the cell.

#### **Example 7: Growth of Genetically Modified *Corynebacterium glutamicum* — Media and Culture Conditions**

Genetically modified *Corynebacteria* are cultured in synthetic or natural growth media. A number of different growth media for *Corynebacteria* are both well-known and readily available (Lieb *et al.* (1989) *Appl. Microbiol. Biotechnol.*, 32:205-210; von der Osten *et al.* (1998) *Biotechnology Letters*, 11:11-16; Patent DE 4,120,867; Liebl (1992) "The Genus *Corynebacterium*, in: The Prokaryotes, Volume II, Balows, A. *et al.*, eds. Springer-Verlag). These media consist of one or more carbon sources, nitrogen sources, inorganic salts, vitamins and trace elements. Preferred carbon sources are sugars, such as mono-, di-, or polysaccharides. For example, glucose, fructose, mannose, galactose, ribose, sorbose, ribulose, lactose, maltose, sucrose, raffinose, starch or cellulose serve as very good carbon sources. It is also possible to supply sugar to the media via complex compounds such as molasses or other by-products from sugar refinement. It can also be

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advantageous to supply mixtures of different carbon sources. Other possible carbon sources are alcohols and organic acids, such as methanol, ethanol, acetic acid or lactic acid. Nitrogen sources are usually organic or inorganic nitrogen compounds, or materials which contain these compounds. Exemplary nitrogen sources include ammonia gas or  
5 ammonia salts, such as  $\text{NH}_4\text{Cl}$  or  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{OH}$ , nitrates, urea, amino acids or complex nitrogen sources like corn steep liquor, soy bean flour, soy bean protein, yeast extract, meat extract and others.

Inorganic salt compounds which may be included in the media include the chloride-, phosphorous- or sulfate- salts of calcium, magnesium, sodium, cobalt,  
10 molybdenum, potassium, manganese, zinc, copper and iron. Chelating compounds can be added to the medium to keep the metal ions in solution. Particularly useful chelating compounds include dihydroxyphenols, like catechol or protocatechuate, or organic acids, such as citric acid. It is typical for the media to also contain other growth factors, such as vitamins or growth promoters, examples of which include biotin, riboflavin, thiamin, folic  
15 acid, nicotinic acid, pantothenate and pyridoxin. Growth factors and salts frequently originate from complex media components such as yeast extract, molasses, corn steep liquor and others. The exact composition of the media compounds depends strongly on the immediate experiment and is individually decided for each specific case. Information about media optimization is available in the textbook "Applied Microbiol. Physiology, A  
20 Practical Approach (*eds.* P.M. Rhodes, P.F. Stanbury, IRL Press (1997) pp. 53-73, ISBN 0 19 963577 3). It is also possible to select growth media from commercial suppliers, like standard 1 (Merck) or BHI (grain heart infusion, DIFCO) or others.

All medium components are sterilized, either by heat (20 minutes at 1.5 bar and 121°C) or by sterile filtration. The components can either be sterilized together or, if  
25 necessary, separately. All media components can be present at the beginning of growth, or they can optionally be added continuously or batchwise.

Culture conditions are defined separately for each experiment. The temperature should be in a range between 15°C and 45°C. The temperature can be kept constant or can be altered during the experiment. The pH of the medium should be in the range of 5 to  
30 8.5, preferably around 7.0, and can be maintained by the addition of buffers to the media. An exemplary buffer for this purpose is a potassium phosphate buffer. Synthetic buffers such as MOPS, HEPES, ACES and others can alternatively or simultaneously be used. It

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is also possible to maintain a constant culture pH through the addition of NaOH or NH<sub>4</sub>OH during growth. If complex medium components such as yeast extract are utilized, the necessity for additional buffers may be reduced, due to the fact that many complex compounds have high buffer capacities. If a fermentor is utilized for culturing the micro-organisms, the pH can also be controlled using gaseous ammonia.

The incubation time is usually in a range from several hours to several days. This time is selected in order to permit the maximal amount of product to accumulate in the broth. The disclosed growth experiments can be carried out in a variety of vessels, such as microtiter plates, glass tubes, glass flasks or glass or metal fermentors of different sizes.

For screening a large number of clones, the microorganisms should be cultured in microtiter plates, glass tubes or shake flasks, either with or without baffles. Preferably 100 ml shake flasks are used, filled with 10% (by volume) of the required growth medium. The flasks should be shaken on a rotary shaker (amplitude 25 mm) using a speed-range of 100 – 300 rpm. Evaporation losses can be diminished by the maintenance of a humid atmosphere; alternatively, a mathematical correction for evaporation losses should be performed.

If genetically modified clones are tested, an unmodified control clone or a control clone containing the basic plasmid without any insert should also be tested. The medium is inoculated to an OD<sub>600</sub> of 0.5 – 1.5 using cells grown on agar plates, such as CM plates (10 g/l glucose, 2,5 g/l NaCl, 2 g/l urea, 10 g/l polypeptone, 5 g/l yeast extract, 5 g/l meat extract, 22 g/l NaCl, 2 g/l urea, 10 g/l polypeptone, 5 g/l yeast extract, 5 g/l meat extract, 22 g/l agar, pH 6.8 with 2M NaOH) that had been incubated at 30°C. Inoculation of the media is accomplished by either introduction of a saline suspension of *C. glutamicum* cells from CM plates or addition of a liquid preculture of this bacterium.

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#### **Example 8 – *In vitro* Analysis of the Function of Mutant Proteins**

The determination of activities and kinetic parameters of enzymes is well established in the art. Experiments to determine the activity of any given altered enzyme must be tailored to the specific activity of the wild-type enzyme, which is well within the ability of one of ordinary skill in the art. Overviews about enzymes in general, as well as specific details concerning structure, kinetics, principles, methods, applications and examples for the determination of many enzyme activities may be

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found, for example, in the following references: Dixon, M., and Webb, E.C., (1979) Enzymes. Longmans: London; Fersht, (1985) Enzyme Structure and Mechanism. Freeman: New York; Walsh, (1979) Enzymatic Reaction Mechanisms. Freeman: San Francisco; Price, N.C., Stevens, L. (1982) Fundamentals of Enzymology. Oxford Univ. Press: Oxford; Boyer, P.D., ed. (1983) The Enzymes, 3<sup>rd</sup> ed. Academic Press: New York; Bisswanger, H., (1994) Enzymkinetik, 2<sup>nd</sup> ed. VCH: Weinheim (ISBN 3527300325); Bergmeyer, H.U., Bergmeyer, J., Graßl, M., eds. (1983-1986) Methods of Enzymatic Analysis, 3<sup>rd</sup> ed., vol. I-XII, Verlag Chemie: Weinheim; and Ullmann's Encyclopedia of Industrial Chemistry (1987) vol. A9, "Enzymes". VCH: Weinheim, p. 352-363.

The activity of proteins which bind to DNA can be measured by several well-established methods, such as DNA band-shift assays (also called gel retardation assays). The effect of such proteins on the expression of other molecules can be measured using reporter gene assays (such as that described in Kolmar, H. *et al.* (1995) *EMBO J.* 14: 3895-3904 and references cited therein). Reporter gene test systems are well known and established for applications in both pro- and eukaryotic cells, using enzymes such as beta-galactosidase, green fluorescent protein, and several others.

The determination of activity of membrane-transport proteins can be performed according to techniques such as those described in Gennis, R.B. (1989) "Pores, Channels and Transporters", in Biomembranes, Molecular Structure and Function, Springer: Heidelberg, p. 85-137; 199-234; and 270-322.

#### **Example 9: Analysis of Impact of Mutant Protein on the Production of the Desired Product**

The effect of the genetic modification in *C. glutamicum* on production of a desired compound (such as an amino acid) can be assessed by growing the modified microorganism under suitable conditions (such as those described above) and analyzing the medium and/or the cellular component for increased production of the desired product (*i.e.*, an amino acid). Such analysis techniques are well known to one of ordinary skill in the art, and include spectroscopy, thin layer chromatography, staining methods of various kinds, enzymatic and microbiological methods, and analytical chromatography such as high performance liquid chromatography (see, for example,

Ullman, Encyclopedia of Industrial Chemistry, vol. A2, p. 89-90 and p. 443-613, VCH: Weinheim (1985); Fallon, A. *et al.*, (1987) "Applications of HPLC in Biochemistry" in: Laboratory Techniques in Biochemistry and Molecular Biology, vol. 17; Rehm *et al.* (1993) Biotechnology, vol. 3, Chapter III: "Product recovery and purification", page  
5 469-714, VCH: Weinheim; Belter, P.A. *et al.* (1988) Bioseparations: downstream processing for biotechnology, John Wiley and Sons; Kennedy, J.F. and Cabral, J.M.S. (1992) Recovery processes for biological materials, John Wiley and Sons; Shaeiwitz, J.A. and Henry, J.D. (1988) Biochemical separations, in: Ulmann's Encyclopedia of Industrial Chemistry, vol. B3, Chapter 11, page 1-27, VCH: Weinheim; and Dechow,  
10 F.J. (1989) Separation and purification techniques in biotechnology, Noyes Publications.)

In addition to the measurement of the final product of fermentation, it is also possible to analyze other components of the metabolic pathways utilized for the production of the desired compound, such as intermediates and side-products, to  
15 determine the overall yield, production, and/or efficiency of production of the compound. Analysis methods include measurements of nutrient levels in the medium (*e.g.*, sugars, hydrocarbons, nitrogen sources, phosphate, and other ions), measurements of biomass composition and growth, analysis of the production of common metabolites of biosynthetic pathways, and measurement of gasses produced during fermentation.  
20 Standard methods for these measurements are outlined in Applied Microbial Physiology, A Practical Approach, P.M. Rhodes and P.F. Stanbury, eds., IRL Press, p. 103-129; 131-163; and 165-192 (ISBN: 0199635773) and references cited therein.

#### **Example 10: Purification of the Desired Product from *C. glutamicum* Culture**

25 Recovery of the desired product from the *C. glutamicum* cells or supernatant of the above-described culture can be performed by various methods well known in the art. If the desired product is not secreted from the cells, the cells can be harvested from the culture by low-speed centrifugation, the cells can be lysed by standard techniques, such as mechanical force or sonication. The cellular debris is removed by centrifugation, and  
30 the supernatant fraction containing the soluble proteins is retained for further purification of the desired compound. If the product is secreted from the *C. glutamicum*

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cells, then the cells are removed from the culture by low-speed centrifugation, and the supernate fraction is retained for further purification.

The supernatant fraction from either purification method is subjected to chromatography with a suitable resin, in which the desired molecule is either retained on a chromatography resin while many of the impurities in the sample are not, or where the impurities are retained by the resin while the sample is not. Such chromatography steps may be repeated as necessary, using the same or different chromatography resins. One of ordinary skill in the art would be well-versed in the selection of appropriate chromatography resins and in their most efficacious application for a particular molecule to be purified. The purified product may be concentrated by filtration or ultrafiltration, and stored at a temperature at which the stability of the product is maximized.

There are a wide array of purification methods known to the art and the preceding method of purification is not meant to be limiting. Such purification techniques are described, for example, in Bailey, J.E. & Ollis, D.F. *Biochemical Engineering Fundamentals*, McGraw-Hill: New York (1986).

The identity and purity of the isolated compounds may be assessed by techniques standard in the art. These include high-performance liquid chromatography (HPLC), spectroscopic methods, staining methods, thin layer chromatography, NIRS, enzymatic assay, or microbiologically. Such analysis methods are reviewed in: Patek *et al.* (1994) *Appl. Environ. Microbiol.* 60: 133-140; Malakhova *et al.* (1996) *Biotekhnologiya* 11: 27-32; and Schmidt *et al.* (1998) *Bioprocess Engineer.* 19: 67-70. Ulmann's Encyclopedia of Industrial Chemistry, (1996) vol. A27, VCH: Weinheim, p. 89-90, p. 521-540, p. 540-547, p. 559-566, 575-581 and p. 581-587; Michal, G. (1999) *Biochemical Pathways: An Atlas of Biochemistry and Molecular Biology*, John Wiley and Sons; Fallon, A. *et al.* (1987) *Applications of HPLC in Biochemistry in: Laboratory Techniques in Biochemistry and Molecular Biology*, vol. 17.

#### **EXAMPLE 11: Cloning of a *Corynebacterium glutamicum* Gene Involved in Lincomycin Resistance Using a Reporter Gene Approach**

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##### *A. Identification of the Gene Encoding the LMRB Protein*

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Plasmid pSL130 was constructed by ligation of the *aceB* promoter region (paceB) of *C. glutamicum* (Kim, H.J. *et al.* (1997) *J. Microbiol. Biotechnol.* 7: 287-292) into the polylinker of the lac operon fusion vector pRS415, which lacks a promoter (Simon, R.W. *et al.* (1987) *Gene* 53: 85-96). Plasmid pSL145 was constructed by  
5 ligating the resulting paceB-lac region into the *E. coli* cloning vector pACYC184. *E. coli* DH5αF' was transformed with pSL145 and the resulting strain was used as a host for screening of a genomic *C. glutamicum* library (in pSL109).

Transformants were screened by growth on agar medium containing 5-bromo-4-chloro-3-indolyl-beta-D-galactopyranoside (X-Gal). A white colony, containing DNA  
10 influencing lacZ expression, was selected for further analysis. This clone was found to contain a 4 kB fragment from the gene library. Subclones were constructed in pSL109 and a subclone which retained the white phenotype on X-Gal plates was identified. This subclone was found to contain a 2.6 kB BamHI-XhoI fragment (plasmid pSL149-5). The fragment was sequenced and identified as a membrane protein-encoding gene  
15 (LMRB gene).

The 1442 nucleotides of the coding sequence of the LMRB gene encode a polypeptide of 481 amino acid residues with a high percentage of hydrophobic amino acids. A Genbank search determined that the LMRB protein is 40% identical to the protein product of the *lmrB* gene from *Bacillus subtilis* (Genbank Accession AL009126,  
20 TREMBL Accession P94422), as determined using a CLUSTAL W analysis (using standard parameters).

The LMRN protein contains a sequence pattern: 158-A-P-A-L-G-P-T-L-S-G-167 (SEQ ID NO:301), which resembles the known multi-drug-resistance-protein consensus motif G-X-X-X-G-P-X-X-G-G (SEQ ID NO:302) (Paulsen, I.T., and Skurray, R.A.  
25 (1993) *Gene* 124: 1-11). Therefore, the LMRB protein was classified as a drug resistance protein.

#### *B. In vivo Analysis of lmrB Function*

The *lmrB* gene was overexpressed in *C. glutamicum* ASO19E12 (Kim, H.J. *et al.*  
30 (1997) *J. Microbiol. Biotechnol.* 7: 287-292) using the plasmid pSL149-5, described above.

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Disruption of the LMRB gene was accomplished by use of the vector pSL18-lmrB. This vector was constructed as follows: an internal fragment of the LMRB gene was amplified by PCR under standard conditions using primers 5'-CTCCAGGATTGCTCCGAAGG-3' (SEQ ID NO:303) and 5'-CACAGTGGTTGACCACTGGC-3' (SEQ ID NO:304). The resulting PCR product was treated with T7 DNA polymerase and T7 polynucleotide kinase, and was cloned into the SmaI site of plasmid pSL18 (Kim, Y.H. and H.-S. Lee (1996) *J. Microbiol. Biotechnol.* 6: 315-320). The disruption of the LMRB gene in *C. glutamicum* ASO19E12 was performed by conjugation, as previously described (Schwarzer and Puhler (1991) *Bio/Technology* 9:84-87).

*C. glutamicum* cells transformed with pSL149-5 displayed similar resistances as untransformed cells against erythromycin, penicillin G, tetracycline, chloramphenicol, spectinomycin, nalidixic acid, gentamycin, streptomycin, ethidium bromide, carbonyl cyanide m-chlorophenylhydrazone (CCCP), and sodium dodecyl sulfate. Significant differences were observed, however, in the resistance of transformed and untransformed cells to lincomycin.

LMRB-overexpressing *C. glutamicum* cells were found to be able to grow in the presence of 20 µg/ml lincomycin. In contrast, cells which do not overexpress LMRB (or cells carrying a LMRB disruption) were not able to grow on agar media containing 5 µg/ml lincomycin. This effect was clearly visible in liquid culture. LMRB overexpression led to a 9-fold increased resistance (compared to wild-type) against lincomycin and LMRB disruption resulted in a decreased resistance (28% of wild-type) to this antibiotic.

## Example 12: Analysis of the Gene Sequences of the Invention

The comparison of sequences and determination of percent homology between two sequences are art-known techniques, and can be accomplished using a mathematical algorithm, such as the algorithm of Karlin and Altschul (1990) *Proc. Natl. Acad. Sci. USA* 87:2264-68, modified as in Karlin and Altschul (1993) *Proc. Natl. Acad. Sci. USA* 90:5873-77. Such an algorithm is incorporated into the NBLAST and XBLAST programs (version 2.0) of Altschul, *et al.* (1990) *J. Mol. Biol.* 215:403-10. BLAST nucleotide searches can be performed with the NBLAST program, score = 100,



wordlength = 12 to obtain nucleotide sequences homologous to SRT nucleic acid molecules of the invention. BLAST protein searches can be performed with the XBLAST program, score = 50, wordlength = 3 to obtain amino acid sequences homologous to SRT protein molecules of the invention. To obtain gapped alignments  
5 for comparison purposes, Gapped BLAST can be utilized as described in Altschul *et al.*, (1997) *Nucleic Acids Res.* 25(17):3389-3402. When utilizing BLAST and Gapped BLAST programs, one of ordinary skill in the art will know how to optimize the parameters of the program (*e.g.*, XBLAST and NBLAST) for the specific sequence being analyzed.

10 Another example of a mathematical algorithm utilized for the comparison of sequences is the algorithm of Meyers and Miller ((1988) *Comput. Appl. Biosci.* 4: 11-17). Such an algorithm is incorporated into the ALIGN program (version 2.0) which is part of the GCG sequence alignment software package. When utilizing the ALIGN program for comparing amino acid sequences, a PAM120 weight residue table, a gap  
15 length penalty of 12, and a gap penalty of 4 can be used. Additional algorithms for sequence analysis are known in the art, and include ADVANCE and ADAM. described in Torelli and Robotti (1994) *Comput. Appl. Biosci.* 10:3-5; and FASTA, described in Pearson and Lipman (1988) *P.N.A.S.* 85:2444-8.

The percent homology between two amino acid sequences can also be  
20 accomplished using the GAP program in the GCG software package (available at <http://www.gcg.com>), using either a Blosum 62 matrix or a PAM250 matrix, and a gap weight of 12, 10, 8, 6, or 4 and a length weight of 2, 3, or 4. The percent homology between two nucleic acid sequences can be accomplished using the GAP program in the GCG software package, using standard parameters, such as a gap weight of 50 and a  
25 length weight of 3.

A comparative analysis of the gene sequences of the invention with those present in Genbank has been performed using techniques known in the art (see, *e.g.*, Bexevanis and Ouellette, eds. (1998) *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.* John Wiley and Sons: New York). The gene sequences of the invention  
30 were compared to genes present in Genbank in a three-step process. In a first step, a BLASTN analysis (*e.g.*, a local alignment analysis) was performed for each of the sequences of the invention against the nucleotide sequences present in Genbank, and the

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top 500 hits were retained for further analysis. A subsequent FASTA search (*e.g.*, a combined local and global alignment analysis, in which limited regions of the sequences are aligned) was performed on these 500 hits. Each gene sequence of the invention was subsequently globally aligned to each of the top three FASTA hits, using the GAP  
5 program in the GCG software package (using standard parameters). In order to obtain correct results, the length of the sequences extracted from Genbank were adjusted to the length of the query sequences by methods well-known in the art. The results of this analysis are set forth in Table 4. The resulting data is identical to that which would have been obtained had a GAP (global) analysis alone been performed on each of the genes of  
10 the invention in comparison with each of the references in Genbank, but required significantly reduced computational time as compared to such a database-wide GAP (global) analysis. Sequences of the invention for which no alignments above the cutoff values were obtained are indicated on Table 4 by the absence of alignment information. It will further be understood by one of ordinary skill in the art that the GAP alignment  
15 homology percentages set forth in Table 4 under the heading "% homology (GAP)" are listed in the European numerical format, wherein a ',' represents a decimal point. For example, a value of "40,345" in this column represents "40.345%".

### Example 13: Construction and Operation of DNA Microarrays

20 The sequences of the invention may additionally be used in the construction and application of DNA microarrays (the design, methodology, and uses of DNA arrays are well known in the art, and are described, for example, in Schena, M. *et al.* (1995) *Science* 270: 467-470; Wodicka, L. *et al.* (1997) *Nature Biotechnology* 15: 1359-1367; DeSaizieu, A. *et al.* (1998) *Nature Biotechnology* 16: 45-48; and DeRisi, J.L. *et al.*  
25 (1997) *Science* 278: 680-686).

DNA microarrays are solid or flexible supports consisting of nitrocellulose, nylon, glass, silicone, or other materials. Nucleic acid molecules may be attached to the surface in an ordered manner. After appropriate labeling, other nucleic acids or nucleic acid mixtures can be hybridized to the immobilized nucleic acid molecules, and the label  
30 may be used to monitor and measure the individual signal intensities of the hybridized molecules at defined regions. This methodology allows the simultaneous quantification of the relative or absolute amount of all or selected nucleic acids in the applied nucleic

acid sample or mixture. DNA microarrays, therefore, permit an analysis of the expression of multiple (as many as 6800 or more) nucleic acids in parallel (see, *e.g.*, Schena, M. (1996) *BioEssays* 18(5): 427-431).

The sequences of the invention may be used to design oligonucleotide primers  
5 which are able to amplify defined regions of one or more *C. glutamicum* genes by a nucleic acid amplification reaction such as the polymerase chain reaction. The choice and design of the 5' or 3' oligonucleotide primers or of appropriate linkers allows the covalent attachment of the resulting PCR products to the surface of a support medium described above (and also described, for example, Schena, M. *et al.* (1995) *Science* 270:  
10 467-470).

Nucleic acid microarrays may also be constructed by *in situ* oligonucleotide synthesis as described by Wodicka, L. *et al.* (1997) *Nature Biotechnology* 15: 1359-1367. By photolithographic methods, precisely defined regions of the matrix are exposed to light. Protective groups which are photolabile are thereby activated and  
15 undergo nucleotide addition, whereas regions that are masked from light do not undergo any modification. Subsequent cycles of protection and light activation permit the synthesis of different oligonucleotides at defined positions. Small, defined regions of the genes of the invention may be synthesized on microarrays by solid phase oligonucleotide synthesis.

20 The nucleic acid molecules of the invention present in a sample or mixture of nucleotides may be hybridized to the microarrays. These nucleic acid molecules can be labeled according to standard methods. In brief, nucleic acid molecules (*e.g.*, mRNA molecules or DNA molecules) are labeled by the incorporation of isotopically or fluorescently labeled nucleotides, *e.g.*, during reverse transcription or DNA synthesis.  
25 Hybridization of labeled nucleic acids to microarrays is described (*e.g.*, in Schena, M. *et al.* (1995) *supra*; Wodicka, L. *et al.* (1997), *supra*; and DeSaizieu A. *et al.* (1998), *supra*). The detection and quantification of the hybridized molecule are tailored to the specific incorporated label. Radioactive labels can be detected, for example, as described in Schena, M. *et al.* (1995) *supra*) and fluorescent labels may be detected, for  
30 example, by the method of Shalon *et al.* (1996) *Genome Research* 6: 639-645).

The application of the sequences of the invention to DNA microarray technology, as described above, permits comparative analyses of different strains of *C.*

*glutamicum* or other Corynebacteria. For example, studies of inter-strain variations based on individual transcript profiles and the identification of genes that are important for specific and/or desired strain properties such as pathogenicity, productivity and stress tolerance are facilitated by nucleic acid array methodologies. Also, comparisons  
5 of the profile of expression of genes of the invention during the course of a fermentation reaction are possible using nucleic acid array technology.

**Example 14: Analysis of the Dynamics of Cellular Protein Populations  
(Proteomics)**

10 The genes, compositions, and methods of the invention may be applied to study the interactions and dynamics of populations of proteins, termed 'proteomics'. Protein populations of interest include, but are not limited to, the total protein population of *C. glutamicum* (*e.g.*, in comparison with the protein populations of other organisms), those proteins which are active under specific environmental or metabolic conditions (*e.g.*,  
15 during fermentation, at high or low temperature, or at high or low pH), or those proteins which are active during specific phases of growth and development.

Protein populations can be analyzed by various well-known techniques, such as gel electrophoresis. Cellular proteins may be obtained, for example, by lysis or extraction, and may be separated from one another using a variety of electrophoretic  
20 techniques. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) separates proteins largely on the basis of their molecular weight. Isoelectric focusing polyacrylamide gel electrophoresis (IEF-PAGE) separates proteins by their isoelectric point (which reflects not only the amino acid sequence but also posttranslational modifications of the protein). Another, more preferred method of protein analysis is the  
25 consecutive combination of both IEF-PAGE and SDS-PAGE, known as 2-D-gel electrophoresis (described, for example, in Hermann *et al.* (1998) *Electrophoresis* 19: 3217-3221; Fountoulakis *et al.* (1998) *Electrophoresis* 19: 1193-1202; Langen *et al.* (1997) *Electrophoresis* 18: 1184-1192; Antelmann *et al.* (1997) *Electrophoresis* 18: 1451-1463). Other separation techniques may also be utilized for protein separation,  
30 such as capillary gel electrophoresis; such techniques are well known in the art.

Proteins separated by these methodologies can be visualized by standard techniques, such as by staining or labeling. Suitable stains are known in the art, and

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include Coomassie Brilliant Blue, silver stain, or fluorescent dyes such as Sypro Ruby (Molecular Probes). The inclusion of radioactively labeled amino acids or other protein precursors (*e.g.*,  $^{35}\text{S}$ -methionine,  $^{35}\text{S}$ -cysteine,  $^{14}\text{C}$ -labelled amino acids,  $^{15}\text{N}$ -amino acids,  $^{15}\text{NO}_3$  or  $^{15}\text{NH}_4^+$  or  $^{13}\text{C}$ -labelled amino acids) in the medium of *C. glutamicum* permits the labeling of proteins from these cells prior to their separation. Similarly, fluorescent labels may be employed. These labeled proteins can be extracted, isolated and separated according to the previously described techniques.

Proteins visualized by these techniques can be further analyzed by measuring the amount of dye or label used. The amount of a given protein can be determined quantitatively using, for example, optical methods and can be compared to the amount of other proteins in the same gel or in other gels. Comparisons of proteins on gels can be made, for example, by optical comparison, by spectroscopy, by image scanning and analysis of gels, or through the use of photographic films and screens. Such techniques are well-known in the art.

To determine the identity of any given protein, direct sequencing or other standard techniques may be employed. For example, N- and/or C-terminal amino acid sequencing (such as Edman degradation) may be used, as may mass spectrometry (in particular MALDI or ESI techniques (see, *e.g.*, Langen *et al.* (1997) *Electrophoresis* 18: 1184-1192)). The protein sequences provided herein can be used for the identification of *C. glutamicum* proteins by these techniques.

The information obtained by these methods can be used to compare patterns of protein presence, activity, or modification between different samples from various biological conditions (*e.g.*, different organisms, time points of fermentation, media conditions, or different biotopes, among others). Data obtained from such experiments alone, or in combination with other techniques, can be used for various applications, such as to compare the behavior of various organisms in a given (*e.g.*, metabolic) situation, to increase the productivity of strains which produce fine chemicals or to increase the efficiency of the production of fine chemicals.



**Equivalents**

Those of ordinary skill in the art will recognize, or will be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments of the invention described herein. Such equivalents are intended to be encompassed by the

5 following claims.

What is claimed:

1. An isolated nucleic acid molecule from *Corynebacterium glutamicum* encoding a stress, resistance, or tolerance gene, or a portion thereof, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
2. The isolated nucleic acid molecule of claim 1, wherein said stress, resistance, or tolerance gene is selected from the group consisting of nucleic acid molecules involved in a stress response, tolerance, or resistance to temperature stresses, pH stresses, oxygen stresses, osmotic stresses, toxic chemicals, oxygen radicals, antibiotics, or to lincomycin.
3. An isolated *Corynebacterium glutamicum* nucleic acid molecule selected from the group consisting of those sequences set forth as odd-numbered SEQ ID NOs of the Sequence Listing, or a portion thereof, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
4. An isolated nucleic acid molecule which encodes a polypeptide sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
5. An isolated nucleic acid molecule which encodes a naturally occurring allelic variant of a polypeptide selected from the group of amino acid sequences consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
6. An isolated nucleic acid molecule comprising a nucleotide sequence which is at least 50% homologous to a nucleotide sequence selected from the group consisting of those sequences set forth as odd-numbered SEQ ID NOs of the Sequence Listing, or

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a portion thereof, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.

7. An isolated nucleic acid molecule comprising a fragment of at least 15 nucleotides  
5 of a nucleic acid comprising a nucleotide sequence selected from the group consisting of those sequences set forth as odd-numbered SEQ ID NOs of the Sequence Listing, provided that the nucleic acid molecule does not consist of any of the F-designated genes set forth in Table 1.
- 10 8. An isolated nucleic acid molecule which hybridizes to the nucleic acid molecule of any one of claims 1-7 under stringent conditions.
9. An isolated nucleic acid molecule comprising the nucleic acid molecule of any one of claims 1-8 or a portion thereof and a nucleotide sequence encoding a heterologous  
15 polypeptide.
10. A vector comprising the nucleic acid molecule of any one of claims 1-9.
11. The vector of claim 10, which is an expression vector.
- 20 12. A host cell transfected with the expression vector of claim 11.
13. The host cell of claim 12, wherein said cell is a microorganism.
- 25 14. The host cell of claim 13, wherein said cell belongs to the genus *Corynebacterium* or *Brevibacterium*.
15. The host cell of claim 12, wherein the expression of said nucleic acid molecule results in the modulation in production of a fine chemical from said cell.
- 30 16. The host cell of claim 15, wherein said fine chemical is selected from the group consisting of: organic acids, proteinogenic and nonproteinogenic amino acids, purine

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and pyrimidine bases, nucleosides, nucleotides, lipids, saturated and unsaturated fatty acids, diols, carbohydrates, aromatic compounds, vitamins, cofactors, polyketides, and enzymes.

- 5 17. A method of producing a polypeptide comprising culturing the host cell of claim 12 in an appropriate culture medium to, thereby, produce the polypeptide.
18. An isolated stress, resistance, or tolerance polypeptide from *Corynebacterium glutamicum*, or a portion thereof.
- 10 19. The protein of claim 18, wherein said stress, resistance, or tolerance polypeptide is selected from the group consisting of proteins involved in a stress response, tolerance, or resistance to temperature stresses, pH stresses, oxygen stresses, osmotic stresses, toxic chemicals, oxygen radicals, antibiotics, or to lincomycin.
- 15 20. An isolated polypeptide comprising an amino acid sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the amino acid sequence is not encoded by any of the F-designated genes set forth in Table 1.
- 20 21. An isolated polypeptide comprising a naturally occurring allelic variant of a polypeptide comprising an amino acid sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, or a portion thereof, provided that the amino acid sequence is not encoded
- 25 by any of the F-designated genes set forth in Table 1.
22. The isolated polypeptide of any of claims 18-21, further comprising heterologous amino acid sequences.
- 30 23. An isolated polypeptide which is encoded by a nucleic acid molecule comprising a nucleotide sequence which is at least 50% homologous to a nucleic acid selected from the group consisting of those sequences set forth as odd-numbered SEQ ID

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NOs of the Sequence Listing,, provided that the nucleic acid molecule does not consist of any of the F-designated nucleic acid molecules set forth in Table 1.

24. An isolated polypeptide comprising an amino acid sequence which is at least 50% homologous to an amino acid sequence selected from the group consisting of those sequences set forth as even-numbered SEQ ID NOs of the Sequence Listing, provided that the amino acid sequence is not encoded by any of the F-designated genes set forth in Table 1.
25. A method for producing a fine chemical, comprising culturing a cell containing a vector of claim 12 such that the fine chemical is produced.
26. The method of claim 25, wherein said method further comprises the step of recovering the fine chemical from said culture.
27. The method of claim 25, wherein said method further comprises the step of transfecting said cell with the vector of claim 11 to result in a cell containing said vector.
28. The method of claim 25, wherein said cell belongs to the genus *Corynebacterium* or *Brevibacterium*.
29. The method of claim 25, wherein said cell is selected from the group consisting of: *Corynebacterium glutamicum*, *Corynebacterium herculis*, *Corynebacterium lilium*, *Corynebacterium acetoacidophilum*, *Corynebacterium acetoglutamicum*, *Corynebacterium acetophilum*, *Corynebacterium ammoniagenes*, *Corynebacterium fujiokense*, *Corynebacterium nitrilophilus*, *Brevibacterium ammoniagenes*, *Brevibacterium butanicum*, *Brevibacterium divaricatum*, *Brevibacterium flavum*, *Brevibacterium healii*, *Brevibacterium ketoglutamicum*, *Brevibacterium ketosoreductum*, *Brevibacterium lactofermentum*, *Brevibacterium linens*, *Brevibacterium paraffinolyticum*, and those strains set forth in Table 3.



30. The method of claim 25, wherein expression of the nucleic acid molecule from said vector results in modulation of production of said fine chemical.
31. The method of claim 25, wherein said fine chemical is selected from the group  
5 consisting of: organic acids, proteinogenic and nonproteinogenic amino acids, purine and pyrimidine bases, nucleosides, nucleotides, lipids, saturated and unsaturated fatty acids, diols, carbohydrates, aromatic compounds, vitamins, cofactors, polyketides and enzymes.
- 10 32. The method of claim 25, wherein said fine chemical is an amino acid.
33. The method of claim 32, wherein said amino acid is drawn from the group consisting of: lysine, glutamate, glutamine, alanine, aspartate, glycine, serine, threonine, methionine, cysteine, valine, leucine, isoleucine, arginine, proline, histidine,  
15 tyrosine, phenylalanine, and tryptophan.
34. A method for producing a fine chemical, comprising culturing a cell whose genomic DNA has been altered by the inclusion of a nucleic acid molecule of any one of claims 1-9.  
20
35. A method for diagnosing the presence or activity of *Corynebacterium diphtheriae* in a subject, comprising detecting the presence of one or more SEQ ID NOs 1 through 304 of the Sequence Listing in the subject, provided that the sequences are not or are not encoded by any of the F-designated sequences set forth in Table 1, thereby  
25 diagnosing the presence or activity of *Corynebacterium diphtheriae* in the subject.
36. A host cell comprising a nucleic acid molecule selected from the group consisting of the nucleic acid molecules set forth as odd-numbered SEQ ID NOs of the Sequence Listing, wherein the nucleic acid molecule is disrupted.  
30
37. A host cell comprising a nucleic acid molecule selected from the group consisting of the nucleic acid molecules set forth as odd-numbered SEQ ID NOs of the

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Sequence Listing , wherein the nucleic acid molecule comprises one or more nucleic acid modifications from the sequence set forth as odd-numbered SEQ ID NOs of the Sequence Listing .

- 5        38. A host cell comprising a nucleic acid molecule selected from the group consisting of the nucleic acid molecules set as odd-numbered SEQ ID NOs of the Sequence Listing, wherein the regulatory region of the nucleic acid molecule is modified relative to the wild-type regulatory region of the molecule.

## SEQUENCE LISTING

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 <120> CORYNEBACTERIUM GLUTAMICUM GENES ENCODING STRESS,  
 RESISTANCE AND TOLERANCE PROTEINS  
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 <141>  
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 Met Asp Ser Gln Ile  
 1 5  
  
 aat act cag acc tct ccg gca gct gcg aag ctg cct agg gag gtc gtt 163  
 Asn Thr Gln Thr Ser Pro Ala Ala Lys Leu Pro Arg Glu Val Val  
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 Val Val Leu Ser Ile Leu Val Val Ser Ala Met Ile Met Ile Leu Asn  
 25 30 35  
  
 gaa acc att ctg tcg gtt gcg ttg cct tcc atc atg gaa gat ttc tcc 259  
 Glu Thr Ile Leu Ser Val Ala Leu Pro Ser Ile Met Glu Asp Phe Ser  
 40 45 50  
  
 gtg cct gaa act act gca cag tgg ttg acc act ggc ttt atg ttg acg 307  
 Val Pro Glu Thr Thr Ala Gln Trp Leu Thr Thr Gly Phe Met Leu Thr  
 55 60 65  
  
 atg gca gtg gtg att cca act act ggt tat ctg ctt gat cgt ttt tcc 355  
 Met Ala Val Val Ile Pro Thr Thr Gly Tyr Leu Leu Asp Arg Phe Ser  
 70 75 80 85  
  
 act aag acg atc ttt gtt act gcg ttg ttg ttc ttt acg gtt ggt acg 403  
 Thr Lys Thr Ile Phe Val Thr Ala Leu Leu Phe Phe Thr Val Gly Thr  
 90 95 100  
  
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 Leu Thr Ala Ala Leu Ala Pro Thr Phe Ala Val Leu Leu Gly Ala Arg  
 105 110 115  
  
 atc gtt cag gcg gtt ggt act gcg ctg gtg atg cct ttg ctg atg acg 499  
 Ile Val Gln Ala Val Gly Thr Ala Leu Val Met Pro Leu Leu Met Thr

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att att tcc atc gtg att tct gtt gcg ccg gcg ctt ggt cct acg ttg Ile Ile Ser Ile Val Ile Ser Val Ala Pro Ala Leu Gly Pro Thr Leu 150 155 160 165			595
tct ggt gtc att ctt aac tct ttg acc tgg cac tgg ttg ttt tgg atg Ser Gly Val Ile Leu Asn Ser Leu Thr Trp His Trp Leu Phe Trp Met 170 175 180			643
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ctc ggc aag caa gac aaa gca ctg atg gat ctc cga gcc ttc aag gtg Leu Gly Lys Gln Asp Lys Ala Leu Met Asp Leu Arg Ala Phe Lys Val 265 270 275			931
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ctc cag ggt ctg atc agc cca ttc atc gga cgt ttc tac gac aag gtc Leu Gln Gly Leu Ile Ser Pro Phe Ile Gly Arg Phe Tyr Asp Lys Val 330 335 340			1123
ggt cca cgt ccg ctg ctg att ccc gga gca att gcg ctg gct atc gcg Gly Pro Arg Pro Leu Leu Ile Pro Gly Ala Ile Ala Leu Ala Ile Ala 345 350 355			1171

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 Ala Ser Ser Met Thr Phe Leu Asn Glu Asn Ser Pro Val Trp Met Val  
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gtg gtc atg cac gtt gtg ttc agc atc ggc atg tgt ttg atg atg acc 1267  
 Val Val Met His Val Val Phe Ser Ile Gly Met Cys Leu Met Met Thr  
 375 380 385

cct ctc atg acc acc gct ctc ggc gcc ctt ccg aag cac ctc tat ggt 1315  
 Pro Leu Met Thr Thr Ala Leu Gly Ala Leu Pro Lys His Leu Tyr Gly  
 390 395 400 405

cac ggc tcc gca att ttg aac acg ttc caa cag ctc gca ggc gca gcc 1363  
 His Gly Ser Ala Ile Leu Asn Thr Phe Gln Gln Leu Ala Gly Ala Ala  
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 Gly Thr Ala Ile Met Ile Ala Ala Leu Ser Phe Gly Thr Ser Ile Ala  
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Ile Met Ile Leu Asn Glu Thr Ile Leu Ser Val Ala Leu Pro Ser Ile  
 35 40 45

Met Glu Asp Phe Ser Val Pro Glu Thr Thr Ala Gln Trp Leu Thr Thr  
 50 55 60

Gly Phe Met Leu Thr Met Ala Val Val Ile Pro Thr Thr Gly Tyr Leu  
 65 70 75 80



Leu Asp Arg Phe Ser Thr Lys Thr Ile Phe Val Thr Ala Leu Leu Phe  
                             85                            90                            95

Phe Thr Val Gly Thr Leu Thr Ala Ala Leu Ala Pro Thr Phe Ala Val  
                             100                            105                            110

Leu Leu Gly Ala Arg Ile Val Gln Ala Val Gly Thr Ala Leu Val Met  
                             115                            120                            125

Pro Leu Leu Met Thr Val Thr Leu Thr Val Val Pro Ala Glu Arg Arg  
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Gly Ser Met Met Gly Ile Ile Ser Ile Val Ile Ser Val Ala Pro Ala  
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Leu Gly Pro Thr Leu Ser Gly Val Ile Leu Asn Ser Leu Thr Trp His  
                             165                            170                            175

Trp Leu Phe Trp Met Met Leu Pro Ile Val Val Ile Ala Leu Val Ile  
                             180                            185                            190

Gly Phe Phe Leu Ile Lys Asn Ile Gly Glu Thr Lys Ile Thr Pro Leu  
                             195                            200                            205

Asp Val Leu Ser Val Ile Leu Ser Val Phe Ala Phe Gly Gly Leu Val  
                             210                            215                            220

Tyr Gly Phe Ser Ser Phe Gly Ala Ile Leu Glu Gly Glu Gly Thr Val  
 225                            230                            235                            240

Gly Ile Phe Ala Ile Val Val Gly Ala Ile Ala Leu Leu Ile Phe Ala  
                             245                            250                            255

Leu Arg Gln His Gln Leu Gly Lys Gln Asp Lys Ala Leu Met Asp Leu  
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                             275                            280                            285

Leu Ala Phe Gly Ala Met Leu Gly Thr Val Met Val Leu Pro Ile Tyr  
                             290                            295                            300

Leu Gln Thr Ser Leu Gly Val Thr Ala Leu Val Thr Gly Leu Val Val  
 305                            310                            315                            320

Met Pro Gly Gly Leu Leu Gln Gly Leu Ile Ser Pro Phe Ile Gly Arg  
                             325                            330                            335

Phe Tyr Asp Lys Val Gly Pro Arg Pro Leu Leu Ile Pro Gly Ala Ile  
                             340                            345                            350

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                             355                            360                            365

Pro Val Trp Met Val Val Val Met His Val Val Phe Ser Ile Gly Met  
                             370                            375                            380

Cys Leu Met Met Thr Pro Leu Met Thr Thr Ala Leu Gly Ala Leu Pro  
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 Lys His Leu Tyr Gly His Gly Ser Ala Ile Leu Asn Thr Phe Gln Gln  
 405 410 415  
 Leu Ala Gly Ala Ala Gly Thr Ala Ile Met Ile Ala Ala Leu Ser Phe  
 420 425 430  
 Gly Thr Ser Ile Ala Ala Ser Ser Gly Ser Ala His Ala Glu Ala Val  
 435 440 445  
 Ala Ala Gly Thr Lys Val Ala Phe Ile Ala Gly Ala Ile Ile Ala Val  
 450 455 460  
 Ile Ala Leu Val Val Ser Leu Phe Val Thr Arg Val Glu Glu Glu Ala  
 465 470 475 480

His

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 Asn Val Asn Ile Lys Pro Leu Glu Asp Lys Ile Leu Val Gln Ile Asn  
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 Glu Ala Glu Thr Thr Thr Ala Ser Gly Leu Val Ile Pro Asp Ser Ala  
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 Lys Glu Lys Pro Gln Glu Ala Thr Val Ile Ala Val Gly Pro Gly Arg  
 35 40 45 50  
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 Phe Asp Asp Lys Gly Asn Arg Ile Pro Leu Asp Ile Lys Glu Asp Asp  
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 Val Val Ile Phe Ser Arg Tyr Gly Gly Thr Glu Ile Lys Phe Gly Gly  
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gtg gag tac ttg ctt ctc tcc gct cgt gac atc ctc gca atc gtc gag 345  
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Ser Ala Lys Glu Lys Pro Gln Glu Ala Thr Val Ile Ala Val Gly Pro  
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Gly Arg Phe Asp Asp Lys Gly Asn Arg Ile Pro Leu Asp Ile Lys Glu  
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Asp Asp Val Val Ile Phe Ser Arg Tyr Gly Gly Thr Glu Ile Lys Phe  
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 Ala Phe Asp Gln Asp Ala Arg Glu Gly Ile Leu Arg Gly Val Asp Ala  
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Leu Ala Asn Ala Val Lys Val Thr Leu Gly Pro Arg Gly Arg Asn Val	
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Val Leu Asp Lys Ala Phe Gly Gly Pro Leu Val Thr Asn Asp Gly Val	
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Thr Ile Ala Arg Asp Ile Asp Leu Glu Asp Pro Phe Glu Asn Leu Gly	
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gcg cag ctg gtg aag tcc gtt gct gtt aag acc aac gac atc gct ggt	355
Ala Gln Leu Val Lys Ser Val Ala Val Lys Thr Asn Asp Ile Ala Gly	
70 75 80 85	
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Asp Gly Thr Thr Thr Ala Thr Leu Leu Ala Gln Ala Leu Ile Ala Glu	
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Ser Ser Arg Asp Glu Val Val Gly Glu Ile Val Ala Ala Ala Met Glu	
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Lys Val Gly Lys Asp Gly Val Val Thr Val Glu Glu Ser Gln Ser Ile	
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Glu Thr Ala Leu Glu Val Thr Glu Gly Ile Ser Phe Asp Lys Gly Tyr	
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Leu Ser Pro Tyr Phe Ile Asn Asp Asn Asp Thr Gln Gln Ala Val Leu	
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230 235 240 245	

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caa gaa ggc gtt atc gct ggt ggc ggt tcc gct ttg gtt cag atc gct Gln Glu Gly Val Ile Ala Gly Gly Gly Ser Ala Leu Val Gln Ile Ala 410 415 420	1363
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gcc tcc aac gca ggt ctt gac ggc tct gtt gtt gtt gca cgc act gct Ala Ser Asn Ala Gly Leu Asp Gly Ser Val Val Val Ala Arg Thr Ala 455 460 465	1507
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Ala Leu Pro Asn Gly Glu Gly Phe Asn Ala Ala Thr Leu Glu Tyr Gly  
 470 475 480 485

aac ctg atc aac gac ggt gtc atc gac cca gtc aag gtc acc cat tcc 1603  
 Asn Leu Ile Asn Asp Gly Val Ile Asp Pro Val Lys Val Thr His Ser  
 490 495 500

gca gta gtg aat gca acc tct gtt gca cgc atg gtt ctg acc act gag 1651  
 Ala Val Val Asn Ala Thr Ser Val Ala Arg Met Val Leu Thr Thr Glu  
 505 510 515

gct tct gtt gtt gag aag cct gca gaa gaa gca gcc gat gca cat gca 1699  
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 Gly His His His His  
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 35 40 45

Thr Asn Asp Gly Val Thr Ile Ala Arg Asp Ile Asp Leu Glu Asp Pro  
 50 55 60

Phe Glu Asn Leu Gly Ala Gln Leu Val Lys Ser Val Ala Val Lys Thr  
 65 70 75 80

Asn Asp Ile Ala Gly Asp Gly Thr Thr Thr Ala Thr Leu Leu Ala Gln  
 85 90 95

Ala Leu Ile Ala Glu Gly Leu Arg Asn Val Ala Ala Gly Ala Asn Pro  
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Met Glu Leu Asn Lys Gly Ile Ser Ala Ala Ala Glu Lys Thr Leu Glu  
 115 120 125

Glu Leu Lys Ala Arg Ala Thr Glu Val Ser Asp Thr Lys Glu Ile Ala  
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Asn Val Ala Thr Val Ser Ser Arg Asp Glu Val Val Gly Glu Ile Val  
 145 150 155 160

Ala Ala Ala Met Glu Lys Val Gly Lys Asp Gly Val Val Thr Val Glu

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Glu	Ser	Gln	Ser	Ile	Glu	Thr	Ala	Leu	Glu	Val	Thr	Glu	Gly	Ile	Ser				
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Gln	Gln	Ala	Val	Leu	Asp	Asn	Pro	Ala	Val	Leu	Leu	Val	Arg	Asn	Lys				
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Ile	Ser	Ser	Leu	Pro	Asp	Phe	Leu	Pro	Leu	Leu	Glu	Lys	Val	Val	Glu				
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Ser	Asn	Arg	Pro	Leu	Leu	Ile	Ile	Ala	Glu	Asp	Val	Glu	Gly	Glu	Pro				
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Ala	Glu	Asp	Val	Glu	Ala	Arg	Arg	Gly	Gln	Ile	Arg	Arg	Glu	Ile	Ala				
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Asn	Thr	Asp	Ser	Thr	Trp	Asp	Arg	Glu	Lys	Ala	Glu	Glu	Arg	Leu	Ala				
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Lys	Leu	Ser	Gly	Gly	Ile	Ala	Val	Ile	Arg	Val	Gly	Ala	Ala	Thr	Glu				
		370				375					380								
Thr	Glu	Val	Asn	Asp	Arg	Lys	Leu	Arg	Val	Glu	Asp	Ala	Ile	Asn	Ala				
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Ala	Arg	Ala	Ala	Ala	Gln	Glu	Gly	Val	Ile	Ala	Gly	Gly	Gly	Ser	Ala				
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Leu	Val	Gln	Ile	Ala	Glu	Thr	Leu	Lys	Ala	Tyr	Ala	Glu	Glu	Phe	Glu				
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Gly	Asp	Gln	Lys	Val	Gly	Val	Arg	Ala	Leu	Ala	Thr	Ala	Leu	Gly	Lys				
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Pro	Ala	Tyr	Trp	Ile	Ala	Ser	Asn	Ala	Gly	Leu	Asp	Gly	Ser	Val	Val				
		450				455					460								
Val	Ala	Arg	Thr	Ala	Ala	Leu	Pro	Asn	Gly	Glu	Gly	Phe	Asn	Ala	Ala				

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 Thr Leu Glu Tyr Gly Asn Leu Ile Asn Asp Gly Val Ile Asp Pro Val  
                                  485                                   490                                   495  
 Lys Val Thr His Ser Ala Val Val Asn Ala Thr Ser Val Ala Arg Met  
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    Met Ala Lys Leu Ile  
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 gct ttt gac cag gac gcc cgc gaa ggc att ctc cgg ggc gtt gac gct 163  
 Ala Phe Asp Gln Asp Ala Arg Glu Gly Ile Leu Arg Gly Val Asp Ala  
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 ctg gca aac gct gtc aag gta acc ctc ggc cca cgc ggc cgt aac gtg 211  
 Leu Ala Asn Ala Val Lys Val Thr Leu Gly Pro Arg Gly Arg Asn Val  
    25                                   30                                   35  
 gtt ctt gat aag gca ttc ggc gga cct ctg gtc acc aac gac ggt gtc 259  
 Val Leu Asp Lys Ala Phe Gly Gly Pro Leu Val Thr Asn Asp Gly Val  
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 acc att gcc cgc gac atc gac ctt gag gat cct ttt gag aac ctc ggt 307  
 Thr Ile Ala Arg Asp Ile Asp Leu Glu Asp Pro Phe Glu Asn Leu Gly  
    55                                   60                                   65  
 gcg cag ctg gtg aag tcc gtt gct gtt aag acc aac gac atc gct ggt 355  
 Ala Gln Leu Val Lys Ser Val Ala Val Lys Thr Asn Asp Ile Ala Gly  
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 gac ggc acc acg act gca act ctg ctt gct cag gca ctc att gct gaa 403  
 Asp Gly Thr Thr Thr Ala Thr Leu Leu Ala Gln Ala Leu Ile Ala Glu  
    90                                   95                                   100  
 ggc ctg cgc aac gtt gct gct ggc gca aac cca atg gag ctc aac aag 451

Gly	Leu	Arg	Asn	Val	Ala	Ala	Gly	Ala	Asn	Pro	Met	Glu	Leu	Asn	Lys		
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Gly	Ile	Ser	Ala	Ala	Ala	Glu	Lys	Thr	Leu	Glu	Glu	Leu	Lys	Ala	Arg		
		120					125					130					
gca	acc	gag	gtg	tct	gac	acc	aag	gaa	atc	gca	aac	gtc	gct	acc	gtt	547	
Ala	Thr	Glu	Val	Ser	Asp	Thr	Lys	Glu	Ile	Ala	Asn	Val	Ala	Thr	Val		
	135					140					145						
tca	tcc	cgc	gat	gaa	gtt	gtc	ggc	gag	atc	gtt	gct	gca	gcg	atg	gaa	595	
Ser	Ser	Arg	Asp	Glu	Val	Val	Gly	Glu	Ile	Val	Ala	Ala	Ala	Met	Glu		
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aag	gtt	ggc	aag	gac	ggt	gtc	gtc	acc	gtt	gag	gag	tcc	cag	tcc	atc	643	
Lys	Val	Gly	Lys	Asp	Gly	Val	Val	Thr	Val	Glu	Glu	Ser	Gln	Ser	Ile		
				170					175					180			
gag	act	gct	ctc	gag	gtc	acc	gaa	ggt	att	tct	ttc	gac	aag	ggc	tac	691	
Glu	Thr	Ala	Leu	Glu	Val	Thr	Glu	Gly	Ile	Ser	Phe	Asp	Lys	Gly	Tyr		
			185					190					195				
ctt	tcc	cct	tat	ttc	atc	aac	gac	aac	gac	act	cag	cag	gct	gtc	ctg	739	
Leu	Ser	Pro	Tyr	Phe	Ile	Asn	Asp	Asn	Asp	Thr	Gln	Gln	Ala	Val	Leu		
		200					205					210					
gac	aac	cct	gca	gtg	ctg	ctt	gtt	cgc	aac	aag	att	tct	tcc	ctc	cca	787	
Asp	Asn	Pro	Ala	Val	Leu	Leu	Val	Arg	Asn	Lys	Ile	Ser	Ser	Leu	Pro		
	215					220					225						
gac	ttc	ctc	cca	ttg	ctg	gag	aag	gtt	gtg	gag	tcc	aac	cgt	cct	ttg	835	
Asp	Phe	Leu	Pro	Leu	Leu	Glu	Lys	Val	Val	Glu	Ser	Asn	Arg	Pro	Leu		
230					235					240					245		
ctg	atc	atc	gca	gaa	gac	gtc	gag	ggc	gag	cct	ttg	cag	acc	ctg	gtt	883	
Leu	Ile	Ile	Ala	Glu	Asp	Val	Glu	Gly	Glu	Pro	Leu	Gln	Thr	Leu	Val		
				250				255						260			
gtg	aac	tcc	atc	cgc	aag	acc	atc	aag	gtc	gtt	gca	gtg	aag	tcc	cct	931	
Val	Asn	Ser	Ile	Arg	Lys	Thr	Ile	Lys	Val	Val	Ala	Val	Lys	Ser	Pro		
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tac	ttc	ggt	gac	cga	cgc	aag	gcg	ttc	atg	gat	gac	ctg	gct	att	gtc	979	
Tyr	Phe	Gly	Asp	Arg	Arg	Lys	Ala	Phe	Met	Asp	Asp	Leu	Ala	Ile	Val		
		280					285					290					
acc	aag	gca	act	gtc	gtg	gat	cca	gaa	gtg	ggc	atc	aac	ctc	aac	gaa	1027	
Thr	Lys	Ala	Thr	Val	Val	Asp	Pro	Glu	Val	Gly	Ile	Asn	Leu	Asn	Glu		
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Ala	Gly	Glu	Glu	Val	Phe	Gly	Thr	Ala	Arg	Arg	Ile	Thr	Val	Ser	Lys		
310					315					320					325		
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345	350 355		
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Trp Asp Arg Glu Lys Ala Glu Glu Arg Leu Ala Lys Leu Ser Gly Gly			
360	365 370		
att gct gtc atc cgc gtt ggt gca gca act gaa acc gaa gtc aac gac	1267		
Ile Ala Val Ile Arg Val Gly Ala Ala Thr Glu Thr Glu Val Asn Asp			
375	380 385		
cgc aag ctg cgt gtc gaa gat gcc atc aac gct gct cgc gca gca gca	1315		
Arg Lys Leu Arg Val Glu Asp Ala Ile Asn Ala Ala Arg Ala Ala Ala			
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Gln Glu Gly Val Ile Ala Gly Gly			
410			

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 Arg Gly Arg Asn Val Val Leu Asp Lys Ala Phe Gly Gly Pro Leu Val  
 35 40 45  
 Thr Asn Asp Gly Val Thr Ile Ala Arg Asp Ile Asp Leu Glu Asp Pro  
 50 55 60  
 Phe Glu Asn Leu Gly Ala Gln Leu Val Lys Ser Val Ala Val Lys Thr  
 65 70 75 80  
 Asn Asp Ile Ala Gly Asp Gly Thr Thr Thr Ala Thr Leu Leu Ala Gln  
 85 90 95  
 Ala Leu Ile Ala Glu Gly Leu Arg Asn Val Ala Ala Gly Ala Asn Pro  
 100 105 110  
 Met Glu Leu Asn Lys Gly Ile Ser Ala Ala Ala Glu Lys Thr Leu Glu  
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 Glu Leu Lys Ala Arg Ala Thr Glu Val Ser Asp Thr Lys Glu Ile Ala  
 130 135 140  
 Asn Val Ala Thr Val Ser Ser Arg Asp Glu Val Val Gly Glu Ile Val



145		150		155		160									
Ala	Ala	Ala	Met	Glu	Lys	Val	Gly	Lys	Asp	Gly	Val	Val	Thr	Val	Glu
				165					170					175	
Glu	Ser	Gln	Ser	Ile	Glu	Thr	Ala	Leu	Glu	Val	Thr	Glu	Gly	Ile	Ser
			180					185					190		
Phe	Asp	Lys	Gly	Tyr	Leu	Ser	Pro	Tyr	Phe	Ile	Asn	Asp	Asn	Asp	Thr
		195					200					205			
Gln	Gln	Ala	Val	Leu	Asp	Asn	Pro	Ala	Val	Leu	Leu	Val	Arg	Asn	Lys
	210					215					220				
Ile	Ser	Ser	Leu	Pro	Asp	Phe	Leu	Pro	Leu	Leu	Glu	Lys	Val	Val	Glu
225					230					235					240
Ser	Asn	Arg	Pro	Leu	Leu	Ile	Ile	Ala	Glu	Asp	Val	Glu	Gly	Glu	Pro
				245					250					255	
Leu	Gln	Thr	Leu	Val	Val	Asn	Ser	Ile	Arg	Lys	Thr	Ile	Lys	Val	Val
			260					265					270		
Ala	Val	Lys	Ser	Pro	Tyr	Phe	Gly	Asp	Arg	Arg	Lys	Ala	Phe	Met	Asp
		275					280					285			
Asp	Leu	Ala	Ile	Val	Thr	Lys	Ala	Thr	Val	Val	Asp	Pro	Glu	Val	Gly
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Ile	Asn	Leu	Asn	Glu	Ala	Gly	Glu	Glu	Val	Phe	Gly	Thr	Ala	Arg	Arg
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Ile	Thr	Val	Ser	Lys	Asp	Glu	Thr	Ile	Ile	Val	Asp	Gly	Ala	Gly	Ser
				325					330					335	
Ala	Glu	Asp	Val	Glu	Ala	Arg	Arg	Gly	Gln	Ile	Arg	Arg	Glu	Ile	Ala
			340					345					350		
Asn	Thr	Asp	Ser	Thr	Trp	Asp	Arg	Glu	Lys	Ala	Glu	Glu	Arg	Leu	Ala
		355				360						365			
Lys	Leu	Ser	Gly	Gly	Ile	Ala	Val	Ile	Arg	Val	Gly	Ala	Ala	Thr	Glu
	370					375					380				
Thr	Glu	Val	Asn	Asp	Arg	Lys	Leu	Arg	Val	Glu	Asp	Ala	Ile	Asn	Ala
385					390					395					400
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&lt;211&gt; 723

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(700)

&lt;223&gt; RXA01217

&lt;400&gt; 9

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gcggccgagt gtccaccttc atccatgagg agaaatcact atg gca aag tac caa 115
                                         Met Ala Lys Tyr Gln
                                         1                               5

acc att gag gct gct gtc cgc tct gag ttc ggc aag ggc tct gca cgt 163
Thr Ile Glu Ala Ala Val Arg Ser Glu Phe Gly Lys Gly Ser Ala Arg
                        10                               15                               20

cgt gca cgc gtt gct ggc cag atc cct gct gtt gtt tac ggc gca gat 211
Arg Ala Arg Val Ala Gly Gln Ile Pro Ala Val Val Tyr Gly Ala Asp
                        25                               30                               35

gtt gag tcc aac ctg cac gtc acc atc gac cac cgc acc ttc gct gcg 259
Val Glu Ser Asn Leu His Val Thr Ile Asp His Arg Thr Phe Ala Ala
                        40                               45                               50

ctg gtt cgc cag gaa ggc gta aac gct gtt ctt gag ctc gac atc gag 307
Leu Val Arg Gln Glu Gly Val Asn Ala Val Leu Glu Leu Asp Ile Glu
                        55                               60                               65

ggc cag aag cag ctc acc atg atc aag cac atc gac cag aac gtg ctg 355
Gly Gln Lys Gln Leu Thr Met Ile Lys His Ile Asp Gln Asn Val Leu
                        70                               75                               80                               85

acc ttc cac atc gac cac ttg gac ctg ctt gcc att aag cgc ggc gaa 403
Thr Phe His Ile Asp His Leu Asp Leu Leu Ala Ile Lys Arg Gly Glu
                        90                               95                               100

aag gtt gag gtt gac gtt cca gtt atc gtc gag ggc gag cca gct cca 451
Lys Val Glu Val Asp Val Pro Val Ile Val Glu Gly Glu Pro Ala Pro
                        105                               110                               115

ggc acc atg tgg gtt cag gat gct gac acc atc aag gtt gag gct gac 499
Gly Thr Met Trp Val Gln Asp Ala Asp Thr Ile Lys Val Glu Ala Asp
                        120                               125                               130

gtt ctg tcc atc cct gaa gag ttc acc gtt tcc atc gaa ggc ctt gag 547
Val Leu Ser Ile Pro Glu Glu Phe Thr Val Ser Ile Glu Gly Leu Glu
                        135                               140                               145

ctc ggc gca cag atc acc gca gct gac atc aag ctc gag ggc gac acc 595
Leu Gly Ala Gln Ile Thr Ala Ala Asp Ile Lys Leu Glu Gly Asp Thr
                        150                               155                               160                               165

acc ctg gtt gag gat cct gag acc ctc atc gtc aac atc gtt ctc cca 643
Thr Leu Val Glu Asp Pro Glu Thr Leu Ile Val Asn Ile Val Leu Pro
                        170                               175                               180

gct gtc gag gaa gaa gac acc gaa gag gac gaa gca gct gaa gaa gca 691
Ala Val Glu Glu Glu Asp Thr Glu Glu Asp Glu Ala Ala Glu Glu Ala

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185

190

195

gct act gag taagcttttt tagatagctt tat  
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723

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 <212> PRT  
 <213> Corynebacterium glutamicum

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 20 25 30  
 Val Tyr Gly Ala Asp Val Glu Ser Asn Leu His Val Thr Ile Asp His  
 35 40 45  
 Arg Thr Phe Ala Ala Leu Val Arg Gln Glu Gly Val Asn Ala Val Leu  
 50 55 60  
 Glu Leu Asp Ile Glu Gly Gln Lys Gln Leu Thr Met Ile Lys His Ile  
 65 70 75 80  
 Asp Gln Asn Val Leu Thr Phe His Ile Asp His Leu Asp Leu Leu Ala  
 85 90 95  
 Ile Lys Arg Gly Glu Lys Val Glu Val Asp Val Pro Val Ile Val Glu  
 100 105 110  
 Gly Glu Pro Ala Pro Gly Thr Met Trp Val Gln Asp Ala Asp Thr Ile  
 115 120 125  
 Lys Val Glu Ala Asp Val Leu Ser Ile Pro Glu Glu Phe Thr Val Ser  
 130 135 140  
 Ile Glu Gly Leu Glu Leu Gly Ala Gln Ile Thr Ala Ala Asp Ile Lys  
 145 150 155 160  
 Leu Glu Gly Asp Thr Thr Leu Val Glu Asp Pro Glu Thr Leu Ile Val  
 165 170 175  
 Asn Ile Val Leu Pro Ala Val Glu Glu Glu Asp Thr Glu Glu Asp Glu  
 180 185 190  
 Ala Ala Glu Glu Ala Ala Thr Glu  
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 <211> 1603  
 <212> DNA  
 <213> Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (33)..(1580)

&lt;223&gt; RXA00605

&lt;400&gt; 11

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                          1               5

gac cag atc gta gat cgc gga atg cgt cca aag ctt tct gga aac act      101
Asp Gln Ile Val Asp Arg Gly Met Arg Pro Lys Leu Ser Gly Asn Thr
      10               15               20

acc cgc cac aac gga gca cca gtt cca tct gag aac atc tcc gca acc      149
Thr Arg His Asn Gly Ala Pro Val Pro Ser Glu Asn Ile Ser Ala Thr
      25               30               35

gca ggc cca cag ggt cca aac gtt ctc aat gac att cac ctc att gaa      197
Ala Gly Pro Gln Gly Pro Asn Val Leu Asn Asp Ile His Leu Ile Glu
      40               45               50               55

aag ctc gca cac ttt aac cgc gag aac gtt cca gag cgt atc cct cac      245
Lys Leu Ala His Phe Asn Arg Glu Asn Val Pro Glu Arg Ile Pro His
      60               65               70

gca aag ggc cac ggc gct ttc ggt gag ctg cac atc acc gag gac gta      293
Ala Lys Gly His Gly Ala Phe Gly Glu Leu His Ile Thr Glu Asp Val
      75               80               85

tcc gaa tac acc aag gca gac ctg ttc cag cct ggt aag gtc acc ccg      341
Ser Glu Tyr Thr Lys Ala Asp Leu Phe Gln Pro Gly Lys Val Thr Pro
      90               95               100

ctg gct gtt cgc ttc tct act gtt gct ggt gag cag ggc tcc cca gat      389
Leu Ala Val Arg Phe Ser Thr Val Ala Gly Glu Gln Gly Ser Pro Asp
      105               110               115

acc tgg cgc gac gtc cac ggc ttc gct ctt cgc ttc tac acc gaa gag      437
Thr Trp Arg Asp Val His Gly Phe Ala Leu Arg Phe Tyr Thr Glu Glu
      120               125               130               135

ggc aac tac gac atc gtg ggt aac aac acc cca acc ttc ttc ctt cgt      485
Gly Asn Tyr Asp Ile Val Gly Asn Asn Thr Pro Thr Phe Phe Leu Arg
      140               145               150

gac ggc atg aag ttc ccg gac ttc atc cac tca cag aag cgt ctc aac      533
Asp Gly Met Lys Phe Pro Asp Phe Ile His Ser Gln Lys Arg Leu Asn
      155               160               165

aag aac ggt ctg cgc gat gca gac atg cag tgg gat ttc tgg acc cgc      581
Lys Asn Gly Leu Arg Asp Ala Asp Met Gln Trp Asp Phe Trp Thr Arg
      170               175               180

gca cct gaa tct gca cac cag gtg acc tac ctg atg ggt gac cgc ggt      629
Ala Pro Glu Ser Ala His Gln Val Thr Tyr Leu Met Gly Asp Arg Gly

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185	190	195	
acc cct aag acc tcc cgc cac cag gac ggc ttc ggc tcc cac acc ttc			677
Thr Pro Lys Thr Ser Arg His Gln Asp Gly Phe Gly Ser His Thr Phe			
200	205	210	215
cag tgg atc aac gct gaa ggt aag cca gtt tgg gtt aag tac cac ttc			725
Gln Trp Ile Asn Ala Glu Gly Lys Pro Val Trp Val Lys Tyr His Phe			
	220	225	230
aag acc cgc cag ggc tgg gat tgc ttc acc gat gca gaa gca gca aag			773
Lys Thr Arg Gln Gly Trp Asp Cys Phe Thr Asp Ala Glu Ala Ala Lys			
	235	240	245
gtt gca ggc gag aac gct gac tac cag cgc gaa gac ctc tac aac gct			821
Val Ala Gly Glu Asn Ala Asp Tyr Gln Arg Glu Asp Leu Tyr Asn Ala			
	250	255	260
att gaa aac ggc gac ttc cca atc tgg gac gtc aag gtt cag atc atg			869
Ile Glu Asn Gly Asp Phe Pro Ile Trp Asp Val Lys Val Gln Ile Met			
	265	270	275
cct ttc gag gat gca gag aac tac cgc tgg aac cca ttc gac ctg acc			917
Pro Phe Glu Asp Ala Glu Asn Tyr Arg Trp Asn Pro Phe Asp Leu Thr			
280	285	290	295
aag acc tgg tcc cag aag gat tac cca ctg atc cca gtc ggt tac ttc			965
Lys Thr Trp Ser Gln Lys Asp Tyr Pro Leu Ile Pro Val Gly Tyr Phe			
	300	305	310
atc ctg aac cgc aac cca cgc aac ttc ttc gct cag atc gag cag ctt			1013
Ile Leu Asn Arg Asn Pro Arg Asn Phe Phe Ala Gln Ile Glu Gln Leu			
	315	320	325
gca ctg gat cca ggc aac atc gtt cct ggc gtc ggc ctg tcc cca gac			1061
Ala Leu Asp Pro Gly Asn Ile Val Pro Gly Val Gly Leu Ser Pro Asp			
	330	335	340
cgc atg ctc cag gca cgt atc ttc gca tac gct gac cag cag cgt tac			1109
Arg Met Leu Gln Ala Arg Ile Phe Ala Tyr Ala Asp Gln Gln Arg Tyr			
	345	350	355
cgc atc ggc gct aac tac cgc gac ctg cca gtg aac cgt cca atc aac			1157
Arg Ile Gly Ala Asn Tyr Arg Asp Leu Pro Val Asn Arg Pro Ile Asn			
360	365	370	375
gag gtc aac acc tac agc cgc gaa ggt tcc atg cag tac atc ttc gac			1205
Glu Val Asn Thr Tyr Ser Arg Glu Gly Ser Met Gln Tyr Ile Phe Asp			
	380	385	390
gct gag ggc gag cct tcc tac agc cct aac cgc tac gac aag ggc gca			1253
Ala Glu Gly Glu Pro Ser Tyr Ser Pro Asn Arg Tyr Asp Lys Gly Ala			
	395	400	405
ggc tac ctg gat aac ggt acg gat tcc tcc tcc aac cac acc tcc tac			1301
Gly Tyr Leu Asp Asn Gly Thr Asp Ser Ser Ser Asn His Thr Ser Tyr			
	410	415	420



ggc cag gct gat gac atc tac gtc aac cca gac cca cac ggc acc gac 1349  
 Gly Gln Ala Asp Asp Ile Tyr Val Asn Pro Asp Pro His Gly Thr Asp  
 425 430 435  
 ctg gtt cgt gct gct tac gtc aag cac cag gat gat gac gac ttc atc 1397  
 Leu Val Arg Ala Ala Tyr Val Lys His Gln Asp Asp Asp Asp Phe Ile  
 440 445 450 455  
 cag cca ggc atc cta tac cgc gag gtc ctg gat gag ggc gag aag gag 1445  
 Gln Pro Gly Ile Leu Tyr Arg Glu Val Leu Asp Glu Gly Glu Lys Glu  
 460 465 470  
 cga ttg gca gac aac atc tcc aac gca atg cag ggc atc tct gag gca 1493  
 Arg Leu Ala Asp Asn Ile Ser Asn Ala Met Gln Gly Ile Ser Glu Ala  
 475 480 485  
 acc gag cca cgc gtc tac gac tac tgg aac aac gtt gat gag aac ctc 1541  
 Thr Glu Pro Arg Val Tyr Asp Tyr Trp Asn Asn Val Asp Glu Asn Leu  
 490 495 500  
 ggc gct cgc gtc aag gag ctt tac ctc cag aag aag gct taagtccttc 1590  
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<210> 12  
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 <212> PRT  
 <213> Corynebacterium glutamicum

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 35 40 45  
 Asn Asp Ile His Leu Ile Glu Lys Leu Ala His Phe Asn Arg Glu Asn  
 50 55 60  
 Val Pro Glu Arg Ile Pro His Ala Lys Gly His Gly Ala Phe Gly Glu  
 65 70 75 80  
 Leu His Ile Thr Glu Asp Val Ser Glu Tyr Thr Lys Ala Asp Leu Phe  
 85 90 95  
 Gln Pro Gly Lys Val Thr Pro Leu Ala Val Arg Phe Ser Thr Val Ala  
 100 105 110  
 Gly Glu Gln Gly Ser Pro Asp Thr Trp Arg Asp Val His Gly Phe Ala  
 115 120 125

Leu Arg Phe Tyr Thr Glu Glu Gly Asn Tyr Asp Ile Val Gly Asn Asn  
 130 135 140  
 Thr Pro Thr Phe Phe Leu Arg Asp Gly Met Lys Phe Pro Asp Phe Ile  
 145 150 155 160  
 His Ser Gln Lys Arg Leu Asn Lys Asn Gly Leu Arg Asp Ala Asp Met  
 165 170 175  
 Gln Trp Asp Phe Trp Thr Arg Ala Pro Glu Ser Ala His Gln Val Thr  
 180 185 190  
 Tyr Leu Met Gly Asp Arg Gly Thr Pro Lys Thr Ser Arg His Gln Asp  
 195 200 205  
 Gly Phe Gly Ser His Thr Phe Gln Trp Ile Asn Ala Glu Gly Lys Pro  
 210 215 220  
 Val Trp Val Lys Tyr His Phe Lys Thr Arg Gln Gly Trp Asp Cys Phe  
 225 230 235 240  
 Thr Asp Ala Glu Ala Ala Lys Val Ala Gly Glu Asn Ala Asp Tyr Gln  
 245 250 255  
 Arg Glu Asp Leu Tyr Asn Ala Ile Glu Asn Gly Asp Phe Pro Ile Trp  
 260 265 270  
 Asp Val Lys Val Gln Ile Met Pro Phe Glu Asp Ala Glu Asn Tyr Arg  
 275 280 285  
 Trp Asn Pro Phe Asp Leu Thr Lys Thr Trp Ser Gln Lys Asp Tyr Pro  
 290 295 300  
 Leu Ile Pro Val Gly Tyr Phe Ile Leu Asn Arg Asn Pro Arg Asn Phe  
 305 310 315 320  
 Phe Ala Gln Ile Glu Gln Leu Ala Leu Asp Pro Gly Asn Ile Val Pro  
 325 330 335  
 Gly Val Gly Leu Ser Pro Asp Arg Met Leu Gln Ala Arg Ile Phe Ala  
 340 345 350  
 Tyr Ala Asp Gln Gln Arg Tyr Arg Ile Gly Ala Asn Tyr Arg Asp Leu  
 355 360 365  
 Pro Val Asn Arg Pro Ile Asn Glu Val Asn Thr Tyr Ser Arg Glu Gly  
 370 375 380  
 Ser Met Gln Tyr Ile Phe Asp Ala Glu Gly Glu Pro Ser Tyr Ser Pro  
 385 390 395 400  
 Asn Arg Tyr Asp Lys Gly Ala Gly Tyr Leu Asp Asn Gly Thr Asp Ser  
 405 410 415  
 Ser Ser Asn His Thr Ser Tyr Gly Gln Ala Asp Asp Ile Tyr Val Asn  
 420 425 430

Pro Asp Pro His Gly Thr Asp Leu Val Arg Ala Ala Tyr Val Lys His  
435 440 445

Gln Asp Asp Asp Asp Phe Ile Gln Pro Gly Ile Leu Tyr Arg Glu Val  
450 455 460

Leu Asp Glu Gly Glu Lys Glu Arg Leu Ala Asp Asn Ile Ser Asn Ala  
465 470 475 480

Met Gln Gly Ile Ser Glu Ala Thr Glu Pro Arg Val Tyr Asp Tyr Trp  
485 490 495

Asn Asn Val Asp Glu Asn Leu Gly Ala Arg Val Lys Glu Leu Tyr Leu  
500 505 510

Gln Lys Lys Ala  
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<210> 13

<211> 2439

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(2416)

<223> RXA00404

<400> 13

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Val Ala Leu Lys Arg  
1 5

ccc gaa gag aaa aca gta aag atc gtg acc ata aaa cag act gac aac 163  
Pro Glu Glu Lys Thr Val Lys Ile Val Thr Ile Lys Gln Thr Asp Asn  
10 15 20

atc aat gac gat gat ttg gtg tac agc aac gct act gac ctt cca gta 211  
Ile Asn Asp Asp Asp Leu Val Tyr Ser Asn Ala Thr Asp Leu Pro Val  
25 30 35

ggc gtg aag aag tcc cct aaa atg tca ccg acc gcc cgc gtt ggt ctc 259  
Gly Val Lys Lys Ser Pro Lys Met Ser Pro Thr Ala Arg Val Gly Leu  
40 45 50

ctt gtc ttt ggg gtt atc gcg gcg gtg ggt tgg gga gca atc gct ttc 307  
Leu Val Phe Gly Val Ile Ala Ala Val Gly Trp Gly Ala Ile Ala Phe  
55 60 65

tcc cgt ggc gaa aca atc aac tct gtg tgg ctg gtt ttg gcg gca gtt 355  
Ser Arg Gly Glu Thr Ile Asn Ser Val Trp Leu Val Leu Ala Ala Val  
70 75 80 85

ggt tcc tat atc att gcg ttt tct ttc tat gcc cga ctg att gaa tac	403
Gly Ser Tyr Ile Ile Ala Phe Ser Phe Tyr Ala Arg Leu Ile Glu Tyr	
90 95 100	
aaa gtt gtt aag ccg aaa gat cag cga gca acc ccg gcg gaa tac gtt	451
Lys Val Val Lys Pro Lys Asp Gln Arg Ala Thr Pro Ala Glu Tyr Val	
105 110 115	
aat gac ggc aag gac tat gtc cca acg gat cgt cgt gtg ctt ttt ggc	499
Asn Asp Gly Lys Asp Tyr Val Pro Thr Asp Arg Arg Val Leu Phe Gly	
120 125 130	
cac cac ttt gca gct att gca ggt gcc ggt cca ttg gtt gga cct gtc	547
His His Phe Ala Ala Ile Ala Gly Ala Gly Pro Leu Val Gly Pro Val	
135 140 145	
atg gcc gcg cag atg ggc tac ctg cca ggc acc ttg tgg att atc ctc	595
Met Ala Ala Gln Met Gly Tyr Leu Pro Gly Thr Leu Trp Ile Ile Leu	
150 155 160 165	
ggt gtg att ttc gcc ggt gca gtg cag gac tac cta gtg ctg tgg gtg	643
Gly Val Ile Phe Ala Gly Ala Val Gln Asp Tyr Leu Val Leu Trp Val	
170 175 180	
tct act cgt agg cgt gga cgc tca ctt ggc cag atg gtt cgt gat gaa	691
Ser Thr Arg Arg Arg Gly Arg Ser Leu Gly Gln Met Val Arg Asp Glu	
185 190 195	
atg ggc acg gtc ggt gga gct gcc ggt atc ttg gcg acc atc tcc atc	739
Met Gly Thr Val Gly Gly Ala Ala Gly Ile Leu Ala Thr Ile Ser Ile	
200 205 210	
atg atc atc att atc gcg gtg ctc gca ttg atc gtg gtt aat gca ctg	787
Met Ile Ile Ile Ile Ala Val Leu Ala Leu Ile Val Val Asn Ala Leu	
215 220 225	
gct gat tca cca tgg ggc gtt ttc tcc atc acc atg acc atc cca att	835
Ala Asp Ser Pro Trp Gly Val Phe Ser Ile Thr Met Thr Ile Pro Ile	
230 235 240 245	
gca ctg ttc atg ggt gtg tac ttg cgt tac ctg cgc cca ggt cgt gtt	883
Ala Leu Phe Met Gly Val Tyr Leu Arg Tyr Leu Arg Pro Gly Arg Val	
250 255 260	
act gaa gtg tcc atc atc ggt gtg gca ctg ctc ctg ctg gct atc gtt	931
Thr Glu Val Ser Ile Ile Gly Val Ala Leu Leu Leu Leu Ala Ile Val	
265 270 275	
gct ggt ggt tgg gtt gca gac acc tca tgg ggc gtg gaa tgg ttc acc	979
Ala Gly Gly Trp Val Ala Asp Thr Ser Trp Gly Val Glu Trp Phe Thr	
280 285 290	
tgg tct aag acc act ttg gcg ttg gcc ttg atc ggt tac gga atc atg	1027
Trp Ser Lys Thr Thr Leu Ala Leu Ala Leu Ile Gly Tyr Gly Ile Met	
295 300 305	
gct gcg att ttg ccg gtg tgg ctg ctg ctt gca ccg cgc gat tac ctg	1075

Ala	Ala	Ile	Leu	Pro	Val	Trp	Leu	Leu	Leu	Ala	Pro	Arg	Asp	Tyr	Leu	
310					315					320					325	
tct	acc	ttt	atg	aag	atc	ggc	gtc	atc	ggg	ctg	ttg	gca	gtg	ggg	att	1123
Ser	Thr	Phe	Met	Lys	Ile	Gly	Val	Ile	Gly	Leu	Leu	Ala	Val	Gly	Ile	
				330					335					340		
ttg	ttc	gca	cgt	cct	gag	gtg	cag	atg	cct	tcc	gtg	acc	tcc	ttc	gca	1171
Leu	Phe	Ala	Arg	Pro	Glu	Val	Gln	Met	Pro	Ser	Val	Thr	Ser	Phe	Ala	
			345					350					355			
ctt	gag	ggc	aac	ggg	ccg	gtg	ttc	tct	gga	agt	ctg	ttc	cca	ttc	ctg	1219
Leu	Glu	Gly	Asn	Gly	Pro	Val	Phe	Ser	Gly	Ser	Leu	Phe	Pro	Phe	Leu	
		360					365				370					
ttc	atc	acg	att	gcc	tgt	ggg	gca	ctg	tct	ggg	ttc	cac	gca	ctg	att	1267
Phe	Ile	Thr	Ile	Ala	Cys	Gly	Ala	Leu	Ser	Gly	Phe	His	Ala	Leu	Ile	
	375					380				385						
tct	tca	gga	acc	aca	cca	aag	ctt	gtg	gag	aag	gaa	tcc	cag	atg	cgc	1315
Ser	Ser	Gly	Thr	Thr	Pro	Lys	Leu	Val	Glu	Lys	Glu	Ser	Gln	Met	Arg	
390					395				400						405	
atg	ctc	ggc	tac	ggc	ggc	atg	ttg	atg	gaa	tct	ttc	gtg	gcg	atg	atg	1363
Met	Leu	Gly	Tyr	Gly	Gly	Met	Leu	Met	Glu	Ser	Phe	Val	Ala	Met	Met	
			410					415					420			
gca	ctg	atc	acc	gct	gtt	att	ctg	gat	cgt	cac	ctg	tac	ttc	tcc	atg	1411
Ala	Leu	Ile	Thr	Ala	Val	Ile	Leu	Asp	Arg	His	Leu	Tyr	Phe	Ser	Met	
			425				430						435			
aac	gct	ccg	ctg	gca	ctg	act	ggg	gga	gat	cca	gca	acc	gca	gct	gag	1459
Asn	Ala	Pro	Leu	Ala	Leu	Thr	Gly	Gly	Asp	Pro	Ala	Thr	Ala	Ala	Glu	
		440					445				450					
tgg	gtt	aac	tcc	att	ggg	ctg	aca	ggg	gag	gat	atc	acc	ccg	gaa	cag	1507
Trp	Val	Asn	Ser	Ile	Gly	Leu	Thr	Gly	Ala	Asp	Ile	Thr	Pro	Glu	Gln	
	455				460				465							
ctg	tcg	gaa	gct	gct	gaa	agt	gtc	gga	gaa	tcc	act	gtt	att	tcc	cgt	1555
Leu	Ser	Glu	Ala	Ala	Glu	Ser	Val	Gly	Glu	Ser	Thr	Val	Ile	Ser	Arg	
470					475				480						485	
acc	ggg	ggc	gca	cca	acc	ttg	gag	ttc	ggg	atg	tct	gaa	atc	ctc	tcc	1603
Thr	Gly	Gly	Ala	Pro	Thr	Leu	Ala	Phe	Gly	Met	Ser	Glu	Ile	Leu	Ser	
			490					495					500			
gga	ttc	atc	ggc	ggc	gct	gga	atg	aag	gag	ttc	tgg	tac	cac	ttc	gcc	1651
Gly	Phe	Ile	Gly	Gly	Ala	Gly	Met	Lys	Ala	Phe	Trp	Tyr	His	Phe	Ala	
			505				510						515			
atc	atg	ttt	gag	gct	ctg	ttc	atc	ctc	act	act	gtg	gat	gca	ggg	act	1699
Ile	Met	Phe	Glu	Ala	Leu	Phe	Ile	Leu	Thr	Thr	Val	Asp	Ala	Gly	Thr	
		520					525				530					
cgt	gtg	gct	cgc	ttt	atg	atg	acc	gat	acc	ttg	ggc	aat	gtt	cca	ggg	1747
Arg	Val	Ala	Arg	Phe	Met	Met	Thr	Asp	Thr	Leu	Gly	Asn	Val	Pro	Gly	



535	540	545	
ctg cgc cgt ttc aag gat cct tca tgg act gtc ggt aac tgg att tct Leu Arg Arg Phe Lys Asp Pro Ser Trp Thr Val Gly Asn Trp Ile Ser 550 555 560 565			1795
acc gtg ttt gtg tgt gct cta tgg ggt gct att ttg ctc atg ggt gtt Thr Val Phe Val Cys Ala Leu Trp Gly Ala Ile Leu Leu Met Gly Val 570 575 580			1843
acc gat cca ctg ggc ggc atc aac gtg ctt ttc cca cta ttc ggt atc Thr Asp Pro Leu Gly Gly Ile Asn Val Leu Phe Pro Leu Phe Gly Ile 585 590 595			1891
gct aac cag ctg ctc gcc gct att gca ctt gct ctc gtg ctg gtt gtt Ala Asn Gln Leu Leu Ala Ala Ile Ala Leu Ala Leu Val Leu Val Val 600 605 610			1939
gtg gtg aag aag ggc ctg tac aag tgg gcg tgg att cca gct gtt cct Val Val Lys Lys Gly Leu Tyr Lys Trp Ala Trp Ile Pro Ala Val Pro 615 620 625			1987
ttg gca tgg gat ctc att gtc acg atg act gcg tca tgg cag aag att Leu Ala Trp Asp Leu Ile Val Thr Met Thr Ala Ser Trp Gln Lys Ile 630 635 640 645			2035
ttc cac tct gat ccg gct att ggc tac tgg gct cag aac gcg aac ttc Phe His Ser Asp Pro Ala Ile Gly Tyr Trp Ala Gln Asn Ala Asn Phe 650 655 660			2083
cgc gat gca aag tct caa ggc ctt acc gaa ttt ggt gcc gct aaa tct Arg Asp Ala Lys Ser Gln Gly Leu Thr Glu Phe Gly Ala Ala Lys Ser 665 670 675			2131
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gac gag cgc tac cca ggc ggt gcg ccc gtg tct tct gga ggg cac Asp Glu Arg Tyr Pro Gly Gly Ala Pro Val Ser Ser Gly Gly His 760 765 770			2416

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2439

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&lt;211&gt; 772

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 14

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Gly	Ala	Ile	Ala	Phe	Ser	Arg	Gly	Glu	Thr	Ile	Asn	Ser	Val	Trp	Leu
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Pro	Ala	Glu	Tyr	Val	Asn	Asp	Gly	Lys	Asp	Tyr	Val	Pro	Thr	Asp	Arg
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Arg	Val	Leu	Phe	Gly	His	His	Phe	Ala	Ala	Ile	Ala	Gly	Ala	Gly	Pro
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Leu	Trp	Ile	Ile	Leu	Gly	Val	Ile	Phe	Ala	Gly	Ala	Val	Gln	Asp	Tyr
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Leu	Val	Leu	Trp	Val	Ser	Thr	Arg	Arg	Arg	Gly	Arg	Ser	Leu	Gly	Gln
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Met	Val	Arg	Asp	Glu	Met	Gly	Thr	Val	Gly	Gly	Ala	Ala	Gly	Ile	Leu
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 Ile Pro Ala Val Pro Leu Ala Trp Asp Leu Ile Val Thr Met Thr Ala  
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 Ala Ala Gly Thr Pro Leu Glu Thr Thr Glu Glu Pro Asp Thr Glu Ser  
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 Glu Phe Phe Ala Pro Thr Gly Phe Leu Ala Ser Ser Arg Asp Lys Glu  
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Glu His Ala Phe Tyr Leu Gln Tyr Met Asn Val Lys Ala Asp Tyr Val
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aag gct gtt tgg aac gtc ttc aac tgg gac gac gca aga gca cgc ttc 211
Lys Ala Val Trp Asn Val Phe Asn Trp Asp Asp Ala Arg Ala Arg Phe
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 Met Val Glu Arg Asp  
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 Phe Thr Ile Arg Pro Ile Arg Glu Gly Asp Phe Pro Gln Val Arg Asp  
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 Ile Tyr Glu Leu Gly Leu Glu Thr Gly His Ala Thr Tyr Glu Thr Ser  
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 Gly Pro Thr Trp Asp Gln Phe Ser Gln Ser Lys Ile Met Asp Thr Val  
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Asp Ser Ile Tyr Ile His Pro Gln Gly Gln Gly Arg Gly Ile Gly Gly	90	95	100	
gct ttg ctc gac gcc ctt atc acc tac tgc gaa agc aac ggc atc tgg				451
Ala Leu Leu Asp Ala Leu Ile Thr Tyr Cys Glu Ser Asn Gly Ile Trp	105	110	115	
tcg atc cac tcc tgg atc ttc ccg gaa aac ctc ggt tct gcg aaa ctg				499
Ser Ile His Ser Trp Ile Phe Pro Glu Asn Leu Gly Ser Ala Lys Leu	120	125	130	
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His Glu Ser Lys Gly Phe Val Lys Val Gly Thr Met His Gln Met Ala	135	140	145	
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Arg Met Pro Tyr Gly Glu Met Glu Gly Gln Trp Arg Asp Cys Asp Leu	150	155	160	165
tgg gag tgc ctc tta tcc gtt cca gag caa gct caa agt tcc				637
Trp Glu Cys Leu Ser Val Pro Glu Gln Ala Gln Ser Ser	170	175		
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 Thr Tyr Glu Thr Ser Gly Pro Thr Trp Asp Gln Phe Ser Gln Ser Lys  
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 Ile Met Asp Thr Val Met Val Ala Val Glu Asn Asn Asp Pro Asp Phe  
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 Ile Leu Gly Trp Val Ser Ala Ala Pro Ile Ser Ser Arg Gln Val Phe  
 65 70 75 80  
 His Gly Val Val Glu Asp Ser Ile Tyr Ile His Pro Gln Gly Gln Gly  
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Met His Gln Met Ala Arg Met Pro Tyr Gly Glu Met Glu Gly Gln Trp		
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 Glu Leu Gly Leu Glu Thr Gly His Ala Thr Tyr Glu Thr Ser Gly Pro  
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 Ala Pro Ile Ser Ser Arg Gln Val Phe His Gly Val Val Glu Asp Ser  
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His Ser Trp Ile Phe Pro Glu Asn Leu Gly Ser Ala Lys Leu His Glu  
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 Ser Lys Gly Phe Val Lys Val Gly Thr Met His Gln Met Ala Arg Met  
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ccc tac ggc gag atg gaa gga caa tgg cgc gat tgt gat ctg tgg gag 547  
 Pro Tyr Gly Glu Met Glu Gly Gln Trp Arg Asp Cys Asp Leu Trp Glu  
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tgc ctc tta tcc gtt cca gag caa gct caa agt tcc taaagcaatt 593  
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Gly Trp Val Ser Ala Ala Pro Ile Ser Ser Arg Gln Val Phe His Gly  
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Val Val Glu Asp Ser Ile Tyr Ile His Pro Gln Gly Gln Gly Arg Gly  
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Ile Gly Gly Ala Leu Leu Asp Ala Leu Ile Thr Tyr Cys Glu Ser Asn  
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Gly Ile Trp Ser Ile His Ser Trp Ile Phe Pro Glu Asn Leu Gly Ser  
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Ala Lys Leu His Glu Ser Lys Gly Phe Val Lys Val Gly Thr Met His  
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Gln Met Ala Arg Met Pro Tyr Gly Glu Met Glu Gly Gln Trp Arg Asp  
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Tyr	Pro	Ile	Val	Thr	Val	Glu	Asp	Ser	Leu	Gly	Asp	Thr	His	Asp	Phe	
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Ile	Pro	Ser	Val	Val	Ala	Leu	Lys	Ala	Asp	Arg	Ile	Val	Ala	Gly	Trp	
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Lys	Arg	Leu	Leu	Ser	Glu	Pro	Asn	Val	Thr	Glu	Ala	Thr	Pro	Val	Tyr	
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Thr	Ser	Pro	Ile	Glu	Val	Val	Ile	Gly	Val	Pro	Ala	Asn	Ser	His	Ser	
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Phe Val Arg Ser Phe Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu  
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Ala Thr Pro Val Tyr Leu Gly Asp His Val His Pro Leu Gly Ala Val  
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Thr Gln Leu Gly Asp Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro  
 115 120 125

Ala Asn Ser His Ser Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser  
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Ala Thr Gly Ile Thr Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala  
 145 150 155 160

Ala Phe Glu Tyr Thr His Arg His Ala Arg Thr Leu Asn Ser Lys Arg  
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Gln Ala Ile Val Val Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser  
 180 185 190

Leu Ile Arg Ile Asp Gly Thr His His Glu Val Val Ser Ser Ile Gly  
 195 200 205

Ile Ser Arg Leu Gly Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys  
 210 215 220

Ala Leu Lys Ala Ala Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala  
 225 230 235 240

Lys Asn Thr Leu Leu Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val  
 245 250 255

Pro Gln Ser Arg Arg Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr  
 260 265 270

Val Pro Val Asn Lys Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys  
 275 280 285

Ser Leu Ser Ile Met Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp  
 290 295 300

Ser Asp Ile Ala Gly Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro  
 305 310 315 320

Leu Val Ser Arg Leu Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg  
 325 330 335

Ser Pro Phe Pro Ser Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala  
 340 345 350

Asp Pro Ser Ser Gly Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile  
 355 360 365

Gly Val Phe Arg Glu His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro  
 370 375 380

Leu Ile Ala Pro Asp Thr Asp Ser Ala Thr Val Ala Lys Arg Cys Tyr  
 385 390 395 400

Lys Ala Val His Asn Ile Gly Trp Phe Arg Phe Val Glu Tyr Ser Thr  
 405 410 415

Val Ser Glu Asp Gly Ser Pro Gly Asp Ile Ser Leu Leu Ser Glu Ile  
 420 425 430

Lys Ile Pro Phe Asp Ser Ser Ile Thr Asp Val Asp Ala Thr Glu Ile  
 435 440 445

Ser Arg Phe Asp Gly Pro Glu Val Glu Glu Thr Ile Thr Val Asn Asp  
 450 455 460

Asn Gly Val Ala Ser Ile Ser Ile Lys Ile Leu Gly Gly Val Thr Val  
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Glu His Thr Ile

<210> 25

<211> 1267

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1267)

<223> FRXA01345

<400> 25

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ttccactgca cagcccgaaa atgctgctag ggtcaagttc atg cgt ttt gga ctt 115  
 Met Arg Phe Gly Leu  
 1 5

gac ttg gga act acc cgc aca atc gcg gcc gcc gtg gac cgc gga aac 163  
 Asp Leu Gly Thr Thr Arg Thr Ile Ala Ala Val Asp Arg Gly Asn  
 10 15 20

tat ccc atc gtc act gtg gaa gat tct tta ggc gac acc cac gat ttc 211  
 Tyr Pro Ile Val Thr Val Glu Asp Ser Leu Gly Asp Thr His Asp Phe  
 25 30 35

att cca tct gtg gtg gcc ctc aag gca gat agg att gtc gcg ggt tgg 259  
 Ile Pro Ser Val Val Ala Leu Lys Ala Asp Arg Ile Val Ala Gly Trp  
 40 45 50

gat gct att gag gtt ggg cag gac cac cct tcc ttc gta cgt tct ttc 307  
 Asp Ala Ile Glu Val Gly Gln Asp His Pro Ser Phe Val Arg Ser Phe  
 55 60 65

aaa cgc cta ctc tct gaa ccc aat gtc acg gaa gcc acc ccg gtc tac 355  
 Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu Ala Thr Pro Val Tyr  
 70 75 80 85

ttg ggc gat cat gta cac cct ttg ggc gcc gtc ctg gag gct ttt gcg 403  
 Leu Gly Asp His Val His Pro Leu Gly Ala Val Leu Glu Ala Phe Ala  
 90 95 100

gaa aac gtg gtc act gcg ctg cgt gca ttt cag acg caa ttg gga gat 451  
 Glu Asn Val Val Thr Ala Leu Arg Ala Phe Gln Thr Gln Leu Gly Asp  
 105 110 115

acc tcc ccg atc gaa gta gtc att ggt gtg ccc gcc aac tcc cac agc	499
Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro Ala Asn Ser His Ser	
120 125 130	
gcc cag cga ctg ctc acc atg tcc gcc ttc agc gcc aca ggc atc acc	547
Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser Ala Thr Gly Ile Thr	
135 140 145	
gtt gtc ggt ttg gtc aat gag ccc agc gcc gca gct ttc gag tac acc	595
Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala Ala Phe Glu Tyr Thr	
150 155 160 165	
cac cgc cac gcc cgc acc tta aac tcc aag cgc caa gcc atc gtg gtt	643
His Arg His Ala Arg Thr Leu Asn Ser Lys Arg Gln Ala Ile Val Val	
170 175 180	
tat gat ttg gga ggc gga aca ttc gac tcc tcg ctc atc cgc atc gac	691
Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser Leu Ile Arg Ile Asp	
185 190 195	
ggc acc cac cac gag gtt gtg tcc tcc att ggc att tca cgc ctt ggt	739
Gly Thr His His Glu Val Val Ser Ser Ile Gly Ile Ser Arg Leu Gly	
200 205 210	
ggc gat gat ttc gat gaa atc ctc ctc caa tgc gcg ctc aag gcc gca	787
Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys Ala Leu Lys Ala Ala	
215 220 225	
ggc aga cag cac gat gcg ttt ggc aag cgt gct aaa aac acg ctt ctc	835
Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala Lys Asn Thr Leu Leu	
230 235 240 245	
gac gaa tcc cgc aac gcg aag gaa gct ctt gtt ccg caa tcc cgt cgc	883
Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val Pro Gln Ser Arg Arg	
250 255 260	
ttg gtt cta gaa att ggc gac gac gac atc acc gtt cca gtg aac aag	931
Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr Val Pro Val Asn Lys	
265 270 275	
ttc tac gag gct gcc act ccc ctg gtg gaa aaa tcc ttg tcc atc atg	979
Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys Ser Leu Ser Ile Met	
280 285 290	
gaa ccc ctc atc ggc gtc gat gat ctt aaa gat tcc gac atc gca ggc	1027
Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp Ser Asp Ile Ala Gly	
295 300 305	
atc tac ctt gtt ggt gga gga tcc tcg ctc cca ctc gtt tcc agg ttg	1075
Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro Leu Val Ser Arg Leu	
310 315 320 325	
ctc cgc gag cgt ttc ggc cgc cgt gtc cac cgc tcc cca ttc ccc tca	1123
Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg Ser Pro Phe Pro Ser	
330 335 340	



ggt tcc act gcg gtg ggt ctg gcc atc gcg gct gac cct tcc tct ggt 1171  
 Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala Asp Pro Ser Ser Gly  
                   345                  350                  355

ttc cac cta agg gac cgc gtt gcg cga ggc atc ggt gtg ttc cgt gag 1219  
 Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile Gly Val Phe Arg Glu  
                   360                  365                  370

cac gat tct ggt cgt gcc gtg agc ttt gac ccg ctg atc gcc ccg gac 1267  
 His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro Leu Ile Ala Pro Asp  
                   375                  380                  385

<210> 26

<211> 389

<212> PRT

<213> Corynebacterium glutamicum

<400> 26

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Val Asp Arg Gly Asn Tyr Pro Ile Val Thr Val Glu Asp Ser Leu Gly  
                   20                  25                  30

Asp Thr His Asp Phe Ile Pro Ser Val Val Ala Leu Lys Ala Asp Arg  
                   35                  40                  45

Ile Val Ala Gly Trp Asp Ala Ile Glu Val Gly Gln Asp His Pro Ser  
                   50                  55                  60

Phe Val Arg Ser Phe Lys Arg Leu Leu Ser Glu Pro Asn Val Thr Glu  
   65                  70                  75                  80

Ala Thr Pro Val Tyr Leu Gly Asp His Val His Pro Leu Gly Ala Val  
                   85                  90                  95

Leu Glu Ala Phe Ala Glu Asn Val Val Thr Ala Leu Arg Ala Phe Gln  
                   100                  105                  110

Thr Gln Leu Gly Asp Thr Ser Pro Ile Glu Val Val Ile Gly Val Pro  
                   115                  120                  125

Ala Asn Ser His Ser Ala Gln Arg Leu Leu Thr Met Ser Ala Phe Ser  
                   130                  135                  140

Ala Thr Gly Ile Thr Val Val Gly Leu Val Asn Glu Pro Ser Ala Ala  
   145                  150                  155                  160

Ala Phe Glu Tyr Thr His Arg His Ala Arg Thr Leu Asn Ser Lys Arg  
                   165                  170                  175

Gln Ala Ile Val Val Tyr Asp Leu Gly Gly Gly Thr Phe Asp Ser Ser  
                   180                  185                  190

Leu Ile Arg Ile Asp Gly Thr His His Glu Val Val Ser Ser Ile Gly  
                   195                  200                  205

Ile Ser Arg Leu Gly Gly Asp Asp Phe Asp Glu Ile Leu Leu Gln Cys  
 210 215 220  
 Ala Leu Lys Ala Ala Gly Arg Gln His Asp Ala Phe Gly Lys Arg Ala  
 225 230 235 240  
 Lys Asn Thr Leu Leu Asp Glu Ser Arg Asn Ala Lys Glu Ala Leu Val  
 245 250 255  
 Pro Gln Ser Arg Arg Leu Val Leu Glu Ile Gly Asp Asp Asp Ile Thr  
 260 265 270  
 Val Pro Val Asn Lys Phe Tyr Glu Ala Ala Thr Pro Leu Val Glu Lys  
 275 280 285  
 Ser Leu Ser Ile Met Glu Pro Leu Ile Gly Val Asp Asp Leu Lys Asp  
 290 295 300  
 Ser Asp Ile Ala Gly Ile Tyr Leu Val Gly Gly Gly Ser Ser Leu Pro  
 305 310 315 320  
 Leu Val Ser Arg Leu Leu Arg Glu Arg Phe Gly Arg Arg Val His Arg  
 325 330 335  
 Ser Pro Phe Pro Ser Gly Ser Thr Ala Val Gly Leu Ala Ile Ala Ala  
 340 345 350  
 Asp Pro Ser Ser Gly Phe His Leu Arg Asp Arg Val Ala Arg Gly Ile  
 355 360 365  
 Gly Val Phe Arg Glu His Asp Ser Gly Arg Ala Val Ser Phe Asp Pro  
 370 375 380  
 Leu Ile Ala Pro Asp  
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<210> 27  
 <211> 1308  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1285)  
 <223> RXA02541

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 attcaccgca tataagactc atggaaggag gggatgccca gtg aac aac agc gaa 115  
 Val Asn Asn Ser Glu  
 1 5  
 tgg gca aat aag aac tat tac gca gac ctg ggg gtc tcc tcg tcc gct 163  
 Trp Ala Asn Lys Asn Tyr Tyr Ala Asp Leu Gly Val Ser Ser Ser Ala

	10	15	20	
tca gaa gat gag atc aaa aag gct tac cgc aag ctc gcc agg gaa aat				211
Ser Glu Asp Glu Ile Lys Lys Ala Tyr Arg Lys Leu Ala Arg Glu Asn				
	25	30	35	
cac cca gat aaa aat cca ggt gac aag gcc gct gaa gat cga ttc aaa				259
His Pro Asp Lys Asn Pro Gly Asp Lys Ala Ala Glu Asp Arg Phe Lys				
	40	45	50	
aaa gcg gcc gag gca tat gac gta ctt ggt gat gac aag aaa cga aaa				307
Lys Ala Ala Glu Ala Tyr Asp Val Leu Gly Asp Asp Lys Lys Arg Lys				
	55	60	65	
gaa tac gac gag ctc aaa gca ctt cta gct tct ggt gga atc cgc gga				355
Glu Tyr Asp Glu Leu Lys Ala Leu Leu Ala Ser Gly Gly Ile Arg Gly				
	70	75	80	85
gga ttc gga agc gga ggt gcg gga ttc ccc gcc ggg ttt cgc acg tcg				403
Gly Phe Gly Ser Gly Gly Ala Gly Phe Pro Gly Gly Phe Arg Thr Ser				
	90	95	100	
acg gga gga ttc gac acc tca gac ctc ttc gga gga gga caa ggt gga				451
Thr Gly Gly Phe Asp Thr Ser Asp Leu Phe Gly Gly Gly Gln Gly Gly				
	105	110	115	
ggg ttt tct acg gac gcc ggt ttg gcc gat atc ttc ggt gcc ctt ttc				499
Gly Phe Ser Thr Asp Gly Gly Leu Gly Asp Ile Phe Gly Gly Leu Phe				
	120	125	130	
aac cgc gcc gct ggt tct cac cag tca gct agg ccg acg cgg ggg gcg				547
Asn Arg Gly Ala Gly Ser His Gln Ser Ala Arg Pro Thr Arg Gly Ala				
	135	140	145	
gat gta caa acc gaa ata act ctc tcg ttt gtt gag gca gcg aaa gcc				595
Asp Val Gln Thr Glu Ile Thr Leu Ser Phe Val Glu Ala Ala Lys Gly				
	150	155	160	165
acg acc atc cca gtg gaa ctc acc gcc gat gcg ccc tgc aac acc tgc				643
Thr Thr Ile Pro Val Glu Leu Thr Gly Asp Ala Pro Cys Asn Thr Cys				
	170	175	180	
cac gga tcg gcc tcc aaa tca gcc cac ccc gca aaa tgt gga acc tgt				691
His Gly Ser Gly Ser Lys Ser Gly His Pro Ala Lys Cys Gly Thr Cys				
	185	190	195	
gat gga acc gga ttc acc tct gag aac aag ggt gct ttc gga ttc tcc				739
Asp Gly Thr Gly Phe Thr Ser Glu Asn Lys Gly Ala Phe Gly Phe Ser				
	200	205	210	
gct cca tgt gca acc tgt ggt gcc act ggt gaa ata atc act gat cct				787
Ala Pro Cys Ala Thr Cys Gly Gly Thr Gly Glu Ile Ile Thr Asp Pro				
	215	220	225	
tgc gat aac tgc cac gcc cga gcc acc gtc cgg aag tct cgt tcc atc				835
Cys Asp Asn Cys His Gly Arg Gly Thr Val Arg Lys Ser Arg Ser Ile				
	230	235	240	245

acc gtg cgt atc cca act ggt gtg gaa gat gga cag aaa gtt cgt ctt 883  
 Thr Val Arg Ile Pro Thr Gly Val Glu Asp Gly Gln Lys Val Arg Leu  
 250 255 260

gca ggc caa ggc gaa gca gga cca aat ggc aaa cca gcg ggc gat ctc 931  
 Ala Gly Gln Gly Glu Ala Gly Pro Asn Gly Lys Pro Ala Gly Asp Leu  
 265 270 275

ttt gtg aaa gtc cac gtg aaa aag gac gat gtg ttc aca cgc gac ggc 979  
 Phe Val Lys Val His Val Lys Lys Asp Asp Val Phe Thr Arg Asp Gly  
 280 285 290

agc aac att ttg atc acc att ccc gtg agc ttc agc gag ctg gct ttg 1027  
 Ser Asn Ile Leu Ile Thr Ile Pro Val Ser Phe Ser Glu Leu Ala Leu  
 295 300 305

ggt ggc gct att tct gtg cca acg ctc aac aag cct gta aaa ctc aag 1075  
 Gly Gly Ala Ile Ser Val Pro Thr Leu Asn Lys Pro Val Lys Leu Lys  
 310 315 320 325

cta cct gcg gga acg cca gat ggt cgt act ttg cgt gta cgc ggt cgc 1123  
 Leu Pro Ala Gly Thr Pro Asp Gly Arg Thr Leu Arg Val Arg Gly Arg  
 330 335 340

ggt atc gaa gca cgt gat tcc act ggt gat ctg ctg gtt aca gtc cag 1171  
 Gly Ile Glu Ala Arg Asp Ser Thr Gly Asp Leu Leu Val Thr Val Gln  
 345 350 355

gtt tct gtc ccg aag aat ctg gat gac aac gct gcg gaa gct ctc cgc 1219  
 Val Ser Val Pro Lys Asn Leu Asp Asp Asn Ala Ala Glu Ala Leu Arg  
 360 365 370

gca tat gct gaa gca gaa act aat tca ggt ttt gat ccc cgc gct aac 1267  
 Ala Tyr Ala Glu Ala Glu Thr Asn Ser Gly Phe Asp Pro Arg Ala Asn  
 375 380 385

tgg gcg ggc cag aac cgc tagacgttct ctttgagaaa gga 1308  
 Trp Ala Gly Gln Asn Arg  
 390 395

&lt;210&gt; 28

&lt;211&gt; 395

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 28

Val Asn Asn Ser Glu Trp Ala Asn Lys Asn Tyr Tyr Ala Asp Leu Gly  
 1 5 10 15

Val Ser Ser Ser Ala Ser Glu Asp Glu Ile Lys Lys Ala Tyr Arg Lys  
 20 25 30

Leu Ala Arg Glu Asn His Pro Asp Lys Asn Pro Gly Asp Lys Ala Ala  
 35 40 45

Glu Asp Arg Phe Lys Lys Ala Ala Glu Ala Tyr Asp Val Leu Gly Asp  
 50 55 60  
 Asp Lys Lys Arg Lys Glu Tyr Asp Glu Leu Lys Ala Leu Leu Ala Ser  
 65 70 75 80  
 Gly Gly Ile Arg Gly Gly Phe Gly Ser Gly Gly Ala Gly Phe Pro Gly  
 85 90 95  
 Gly Phe Arg Thr Ser Thr Gly Gly Phe Asp Thr Ser Asp Leu Phe Gly  
 100 105 110  
 Gly Gly Gln Gly Gly Gly Phe Ser Thr Asp Gly Gly Leu Gly Asp Ile  
 115 120 125  
 Phe Gly Gly Leu Phe Asn Arg Gly Ala Gly Ser His Gln Ser Ala Arg  
 130 135 140  
 Pro Thr Arg Gly Ala Asp Val Gln Thr Glu Ile Thr Leu Ser Phe Val  
 145 150 155 160  
 Glu Ala Ala Lys Gly Thr Thr Ile Pro Val Glu Leu Thr Gly Asp Ala  
 165 170 175  
 Pro Cys Asn Thr Cys His Gly Ser Gly Ser Lys Ser Gly His Pro Ala  
 180 185 190  
 Lys Cys Gly Thr Cys Asp Gly Thr Gly Phe Thr Ser Glu Asn Lys Gly  
 195 200 205  
 Ala Phe Gly Phe Ser Ala Pro Cys Ala Thr Cys Gly Gly Thr Gly Glu  
 210 215 220  
 Ile Ile Thr Asp Pro Cys Asp Asn Cys His Gly Arg Gly Thr Val Arg  
 225 230 235 240  
 Lys Ser Arg Ser Ile Thr Val Arg Ile Pro Thr Gly Val Glu Asp Gly  
 245 250 255  
 Gln Lys Val Arg Leu Ala Gly Gln Gly Glu Ala Gly Pro Asn Gly Lys  
 260 265 270  
 Pro Ala Gly Asp Leu Phe Val Lys Val His Val Lys Lys Asp Asp Val  
 275 280 285  
 Phe Thr Arg Asp Gly Ser Asn Ile Leu Ile Thr Ile Pro Val Ser Phe  
 290 295 300  
 Ser Glu Leu Ala Leu Gly Gly Ala Ile Ser Val Pro Thr Leu Asn Lys  
 305 310 315 320  
 Pro Val Lys Leu Lys Leu Pro Ala Gly Thr Pro Asp Gly Arg Thr Leu  
 325 330 335  
 Arg Val Arg Gly Arg Gly Ile Glu Ala Arg Asp Ser Thr Gly Asp Leu  
 340 345 350



Leu Val Thr Val Gln Val Ser Val Pro Lys Asn Leu Asp Asp Asn Ala  
 355 360 365

Ala Glu Ala Leu Arg Ala Tyr Ala Glu Ala Glu Thr Asn Ser Gly Phe  
 370 375 380

Asp Pro Arg Ala Asn Trp Ala Gly Gln Asn Arg  
 385 390 395

<210> 29

<211> 777

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(754)

<223> RXA02542

<400> 29

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 Met Thr Thr Pro Asn  
 1 5  
 gga atg ccc gac aat cct ggg gat cct gaa aat acc gat cca gag gca 163  
 Gly Met Pro Asp Asn Pro Gly Asp Pro Glu Asn Thr Asp Pro Glu Ala  
 10 15 20  
 acc tct gct gat cgt gct gag cag gca gct gaa gaa gca gct gcc cgc 211  
 Thr Ser Ala Asp Arg Ala Glu Gln Ala Ala Glu Glu Ala Ala Ala Arg  
 25 30 35  
 caa gcg gag gaa tct cca ttt gga cag gcc tca gag gaa gaa att tct 259  
 Gln Ala Glu Glu Ser Pro Phe Gly Gln Ala Ser Glu Glu Glu Ile Ser  
 40 45 50  
 cca gag ctc gaa gca gag atc aat gat ctt cta tca gat gtt gat cca 307  
 Pro Glu Leu Glu Ala Glu Ile Asn Asp Leu Leu Ser Asp Val Asp Pro  
 55 60 65  
 gat ttg gat ggc gat ggt gaa gtg tcc gct gta gaa aca cag ctt gcc 355  
 Asp Leu Asp Gly Asp Gly Glu Val Ser Ala Val Glu Thr Gln Leu Ala  
 70 75 80 85  
 gaa cgc act gag gat ctg cag cga gtc acc gct gag tac gcc aac tac 403  
 Glu Arg Thr Glu Asp Leu Gln Arg Val Thr Ala Glu Tyr Ala Asn Tyr  
 90 95 100  
 cgt cga cgt acc gag cgt gaa cgc cag ggc atc atc gac acc gca cgc 451  
 Arg Arg Arg Thr Glu Arg Glu Arg Gln Gly Ile Ile Asp Thr Ala Arg  
 105 110 115  
 gca ggt gtt gtt acc caa ctt ctg ccg ttg ctc gac gat ctt gac ctg 499  
 Ala Gly Val Val Thr Gln Leu Leu Pro Leu Leu Asp Asp Leu Asp Leu

120	125	130	
gct gaa cag cac ggt gac ctt aac gaa ggt ccg ctg aag tca ctg tct			547
Ala Glu Gln His Gly Asp Leu Asn Glu Gly Pro Leu Lys Ser Leu Ser			
135	140	145	
gac aag ctg atc aac atc ctg ggt gga ttg aag gtg gaa tcc ttc ggc			595
Asp Lys Leu Ile Asn Ile Leu Gly Gly Leu Lys Val Glu Ser Phe Gly			
150	155	160	165
gag atc ggc gaa gca ttc gat cca gag atc cac gaa gca gta cag gat			643
Glu Ile Gly Glu Ala Phe Asp Pro Glu Ile His Glu Ala Val Gln Asp			
	170	175	180
ctc tca cag ggt gat gtc aag gtt ctg gga acg gta ctc cgc aag gga			691
Leu Ser Gln Gly Asp Val Lys Val Leu Gly Thr Val Leu Arg Lys Gly			
	185	190	195
tac cgc ctc ggc gac cgc gtc atc cgc acc gca atg gtc ctc att ggg			739
Tyr Arg Leu Gly Asp Arg Val Ile Arg Thr Ala Met Val Leu Ile Gly			
	200	205	210
gat cca gag gag agc tagagagact aagtctcttta gtg			777
Asp Pro Glu Glu Ser			
215			

&lt;210&gt; 30

&lt;211&gt; 218

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 30

Met Thr Thr Pro Asn Gly Met Pro Asp Asn Pro Gly Asp Pro Glu Asn
1 5 10 15

Thr Asp Pro Glu Ala Thr Ser Ala Asp Arg Ala Glu Gln Ala Ala Glu
20 25 30

Glu Ala Ala Ala Arg Gln Ala Glu Glu Ser Pro Phe Gly Gln Ala Ser
35 40 45

Glu Glu Glu Ile Ser Pro Glu Leu Glu Ala Glu Ile Asn Asp Leu Leu
50 55 60

Ser Asp Val Asp Pro Asp Leu Asp Gly Asp Gly Glu Val Ser Ala Val
65 70 75 80

Glu Thr Gln Leu Ala Glu Arg Thr Glu Asp Leu Gln Arg Val Thr Ala
85 90 95

Glu Tyr Ala Asn Tyr Arg Arg Arg Thr Glu Arg Glu Arg Gln Gly Ile
100 105 110

Ile Asp Thr Ala Arg Ala Gly Val Val Thr Gln Leu Leu Pro Leu Leu
115 120 125

Asp Asp Leu Asp Leu Ala Glu Gln His Gly Asp Leu Asn Glu Gly Pro  
 130 135 140

Leu Lys Ser Leu Ser Asp Lys Leu Ile Asn Ile Leu Gly Gly Leu Lys  
 145 150 155 160

Val Glu Ser Phe Gly Glu Ile Gly Glu Ala Phe Asp Pro Glu Ile His  
 165 170 175

Glu Ala Val Gln Asp Leu Ser Gln Gly Asp Val Lys Val Leu Gly Thr  
 180 185 190

Val Leu Arg Lys Gly Tyr Arg Leu Gly Asp Arg Val Ile Arg Thr Ala  
 195 200 205

Met Val Leu Ile Gly Asp Pro Glu Glu Ser  
 210 215

<210> 31

<211> 1977

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1954)

<223> RXN02543

<400> 31

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gtggacagta ctaaaatcac ctaaaacagg aggcaccatt atg gga cgt gca gta 115  
 Met Gly Arg Ala Val  
 1 5

gga att gac ctt gga acc acc aac tct gtg gtt tcc gta ctt gaa ggc 163  
 Gly Ile Asp Leu Gly Thr Thr Asn Ser Val Val Ser Val Leu Glu Gly  
 10 15 20

ggc gag cca gta gtt atc gca aac gca gaa ggc tca cgc acc acc cct 211  
 Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly Ser Arg Thr Thr Pro  
 25 30 35

tcc gtc gtt gca ttc gca aag aac ggt gaa gtt cta gtc ggc cag tcc 259  
 Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val Leu Val Gly Gln Ser  
 40 45 50

gct aag aac cag gcg gtc acc aac gtt gac cgc acc att cgc tcc gtc 307  
 Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg Thr Ile Arg Ser Val  
 55 60 65

aag cgc cac atc ggc acc gac tgg tcc gtt gct atc gat gac aag aac 355  
 Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala Ile Asp Asp Lys Asn  
 70 75 80 85

tac acc tca cag gaa atc tcg gct cgt acc ctg atg aag ctg aag cgc 403

Tyr	Thr	Ser	Gln	Glu	Ile	Ser	Ala	Arg	Thr	Leu	Met	Lys	Leu	Lys	Arg	
				90					95					100		
gac	gct	gaa	gca	tac	ctg	ggc	gag	gac	gtc	act	gat	gct	gtt	att	acc	451
Asp	Ala	Glu	Ala	Tyr	Leu	Gly	Glu	Asp	Val	Thr	Asp	Ala	Val	Ile	Thr	
			105					110					115			
gtt	cct	gca	tac	ttc	gag	gac	tca	cag	cgc	cag	gca	acc	aag	gaa	gct	499
Val	Pro	Ala	Tyr	Phe	Glu	Asp	Ser	Gln	Arg	Gln	Ala	Thr	Lys	Glu	Ala	
		120					125					130				
ggt	cag	atc	gca	ggc	ctt	aac	gtt	ctg	cgt	att	gtt	aac	gag	cca	acc	547
Gly	Gln	Ile	Ala	Gly	Leu	Asn	Val	Leu	Arg	Ile	Val	Asn	Glu	Pro	Thr	
	135					140					145					
gcg	gct	gca	ctt	gca	tac	ggc	ctt	gag	aag	ggc	gag	cag	gag	cag	acc	595
Ala	Ala	Ala	Leu	Ala	Tyr	Gly	Leu	Glu	Lys	Gly	Glu	Gln	Glu	Gln	Thr	
150					155					160					165	
att	ctg	gta	ttc	gac	ctc	ggt	ggc	ggc	acc	ttc	gac	gtc	tcc	ctc	cta	643
Ile	Leu	Val	Phe	Asp	Leu	Gly	Gly	Gly	Thr	Phe	Asp	Val	Ser	Leu	Leu	
			170						175					180		
gag	atc	ggc	gac	ggt	gtt	gtt	gag	gtt	cgc	gca	acc	tcc	ggc	gat	aac	691
Glu	Ile	Gly	Asp	Gly	Val	Val	Glu	Val	Arg	Ala	Thr	Ser	Gly	Asp	Asn	
		185						190					195			
gag	ctc	ggt	ggc	gac	gac	tgg	gat	cag	cgt	atc	gtt	gac	tgg	ctg	gta	739
Glu	Leu	Gly	Gly	Asp	Asp	Trp	Asp	Gln	Arg	Ile	Val	Asp	Trp	Leu	Val	
	200						205					210				
gag	aag	ttc	cag	tcc	tcc	aac	ggc	att	gac	ctg	acc	aag	gac	aag	atg	787
Glu	Lys	Phe	Gln	Ser	Ser	Asn	Gly	Ile	Asp	Leu	Thr	Lys	Asp	Lys	Met	
	215					220					225					
gcc	ctg	cag	cgt	ctg	cgt	gag	gca	gct	gag	aag	gca	aag	atc	gag	ctg	835
Ala	Leu	Gln	Arg	Leu	Arg	Glu	Ala	Ala	Glu	Lys	Ala	Lys	Ile	Glu	Leu	
230					235					240					245	
tcc	tct	tcc	cag	agt	gca	aac	atc	aac	ctt	cct	tac	atc	acc	gtt	gat	883
Ser	Ser	Ser	Gln	Ser	Ala	Asn	Ile	Asn	Leu	Pro	Tyr	Ile	Thr	Val	Asp	
			250						255					260		
gca	gac	aag	aac	cca	ctg	ttc	ttg	gat	gag	acc	ctt	tcc	cgt	gcc	gag	931
Ala	Asp	Lys	Asn	Pro	Leu	Phe	Leu	Asp	Glu	Thr	Leu	Ser	Arg	Ala	Glu	
			265					270					275			
ttc	cag	cgc	atc	acc	cag	gac	ctc	ctg	gcc	cgc	acc	aag	act	cct	ttc	979
Phe	Gln	Arg	Ile	Thr	Gln	Asp	Leu	Leu	Ala	Arg	Thr	Lys	Thr	Pro	Phe	
	280						285					290				
aac	cag	gtt	gtt	aag	gac	gct	ggc	gtg	tcc	gtc	tcg	gag	atc	gac	cac	1027
Asn	Gln	Val	Val	Lys	Asp	Ala	Gly	Val	Ser	Val	Ser	Glu	Ile	Asp	His	
	295					300				305						
gtt	gtt	ctc	gtc	ggt	ggt	tcc	acc	cgt	atg	cct	gct	gtt	acc	gaa	ctg	1075
Val	Val	Leu	Val	Gly	Gly	Ser	Thr	Arg	Met	Pro	Ala	Val	Thr	Glu	Leu	

310	315	320	325	
gtc aag gaa ctg acc ggt gga cgt gag cca aac aag ggt gtt aac cca				1123
Val Lys Glu Leu Thr Gly Gly Arg Glu Pro Asn Lys Gly Val Asn Pro				
	330	335	340	
gat gag gtt gtt gca gtt ggt gca gca ctt cag gcc ggt gtt ctc cgc				1171
Asp Glu Val Val Ala Val Gly Ala Ala Leu Gln Ala Gly Val Leu Arg				
	345	350	355	
ggc gag gtc aag gat gtt ctt ctt ctt gac gtc acc cca ctg tcc ctc				1219
Gly Glu Val Lys Asp Val Leu Leu Leu Asp Val Thr Pro Leu Ser Leu				
	360	365	370	
ggc att gag acc aag ggt ggc gtg atg acc aag ctc atc gag cgc aac				1267
Gly Ile Glu Thr Lys Gly Gly Val Met Thr Lys Leu Ile Glu Arg Asn				
	375	380	385	
acc acc atc cct acc aag cgt tcc gag acc ttc acc acc gca gag gac				1315
Thr Thr Ile Pro Thr Lys Arg Ser Glu Thr Phe Thr Thr Ala Glu Asp				
	390	395	400	405
aac cag cct tct gtt cag atc cag gtc ttc cag ggc gag cgt gaa atc				1363
Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln Gly Glu Arg Glu Ile				
	410	415	420	
gca acc gcc aac aag ctg ctc gga tcc ttc gag ctc ggc ggc atc gca				1411
Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu Leu Gly Gly Ile Ala				
	425	430	435	
cct gca cca cgt ggc gtc cca cag atc gag gtc act ttc gac atc gac				1459
Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val Thr Phe Asp Ile Asp				
	440	445	450	
gcc aac ggc atc gtc cac gtc acc gca aag gac aag ggt act ggc aag				1507
Ala Asn Gly Ile Val His Val Thr Ala Lys Asp Lys Gly Thr Gly Lys				
	455	460	465	
gaa aac acc atc acc att cag gac ggc tcc ggt ctc tcc cag gat gaa				1555
Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly Leu Ser Gln Asp Glu				
	470	475	480	485
att gat cgc atg atc aag gat gct gaa gct cac gct gat gag gac aag				1603
Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His Ala Asp Glu Asp Lys				
	490	495	500	
aag cgc cgc gag gag cag gaa gtc cgc aac aac gct gag tcc ctg gtt				1651
Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn Ala Glu Ser Leu Val				
	505	510	515	
tac cag acc cgc aag ttc gtt gaa gag aac tcc gag aag gtc tcc gaa				1699
Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser Glu Lys Val Ser Glu				
	520	525	530	
gac ctc aag gca aag gtc gaa gag gca gcc aag ggc gtt gaa gaa gca				1747
Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys Gly Val Glu Glu Ala				
	535	540	545	



ctc aag ggc gag gac ctc gag gca atc aag gct gca gtt gag aag ctg 1795  
 Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala Ala Val Glu Lys Leu  
 550 555 560 565

aac acc gag tcc cag gaa atg ggt aag gct atc tac gag gct gac gct 1843  
 Asn Thr Glu Ser Gln Glu Met Gly Lys Ala Ile Tyr Glu Ala Asp Ala  
 570 575 580

gct gct ggt gca acc cag gct gac gca ggt gca gaa ggc gct gca gat 1891  
 Ala Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala Glu Gly Ala Ala Asp  
 585 590 595

gac aat gtt gtt gac gct gaa gtt gtc gaa gac gac gca gct gac aat 1939  
 Asp Asn Val Val Asp Ala Glu Val Val Glu Asp Asp Ala Ala Asp Asn  
 600 605 610

ggt gag gac aag aag taaatgacta cccctaacgg aat 1977  
 Gly Glu Asp Lys Lys  
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<210> 32

<211> 618

<212> PRT

<213> Corynebacterium glutamicum

<400> 32

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 20 25 30

Ser Arg Thr Thr Pro Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val  
 35 40 45

Leu Val Gly Gln Ser Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg  
 50 55 60

Thr Ile Arg Ser Val Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala  
 65 70 75 80

Ile Asp Asp Lys Asn Tyr Thr Ser Gln Glu Ile Ser Ala Arg Thr Leu  
 85 90 95

Met Lys Leu Lys Arg Asp Ala Glu Ala Tyr Leu Gly Glu Asp Val Thr  
 100 105 110

Asp Ala Val Ile Thr Val Pro Ala Tyr Phe Glu Asp Ser Gln Arg Gln  
 115 120 125

Ala Thr Lys Glu Ala Gly Gln Ile Ala Gly Leu Asn Val Leu Arg Ile  
 130 135 140

Val Asn Glu Pro Thr Ala Ala Ala Leu Ala Tyr Gly Leu Glu Lys Gly  
 145 150 155 160

Glu Gln Glu Gln Thr Ile Leu Val Phe Asp Leu Gly Gly Gly Thr Phe  
 165 170 175  
 Asp Val Ser Leu Leu Glu Ile Gly Asp Gly Val Val Glu Val Arg Ala  
 180 185 190  
 Thr Ser Gly Asp Asn Glu Leu Gly Gly Asp Asp Trp Asp Gln Arg Ile  
 195 200 205  
 Val Asp Trp Leu Val Glu Lys Phe Gln Ser Ser Asn Gly Ile Asp Leu  
 210 215 220  
 Thr Lys Asp Lys Met Ala Leu Gln Arg Leu Arg Glu Ala Ala Glu Lys  
 225 230 235 240  
 Ala Lys Ile Glu Leu Ser Ser Ser Gln Ser Ala Asn Ile Asn Leu Pro  
 245 250 255  
 Tyr Ile Thr Val Asp Ala Asp Lys Asn Pro Leu Phe Leu Asp Glu Thr  
 260 265 270  
 Leu Ser Arg Ala Glu Phe Gln Arg Ile Thr Gln Asp Leu Leu Ala Arg  
 275 280 285  
 Thr Lys Thr Pro Phe Asn Gln Val Val Lys Asp Ala Gly Val Ser Val  
 290 295 300  
 Ser Glu Ile Asp His Val Val Leu Val Gly Gly Ser Thr Arg Met Pro  
 305 310 315 320  
 Ala Val Thr Glu Leu Val Lys Glu Leu Thr Gly Gly Arg Glu Pro Asn  
 325 330 335  
 Lys Gly Val Asn Pro Asp Glu Val Val Ala Val Gly Ala Ala Leu Gln  
 340 345 350  
 Ala Gly Val Leu Arg Gly Glu Val Lys Asp Val Leu Leu Leu Asp Val  
 355 360 365  
 Thr Pro Leu Ser Leu Gly Ile Glu Thr Lys Gly Gly Val Met Thr Lys  
 370 375 380  
 Leu Ile Glu Arg Asn Thr Thr Ile Pro Thr Lys Arg Ser Glu Thr Phe  
 385 390 395 400  
 Thr Thr Ala Glu Asp Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln  
 405 410 415  
 Gly Glu Arg Glu Ile Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu  
 420 425 430  
 Leu Gly Gly Ile Ala Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val  
 435 440 445  
 Thr Phe Asp Ile Asp Ala Asn Gly Ile Val His Val Thr Ala Lys Asp  
 450 455 460

Lys Gly Thr Gly Lys Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly  
 465 470 475 480  
 Leu Ser Gln Asp Glu Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His  
 485 490 495  
 Ala Asp Glu Asp Lys Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn  
 500 505 510  
 Ala Glu Ser Leu Val Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser  
 515 520 525  
 Glu Lys Val Ser Glu Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys  
 530 535 540  
 Gly Val Glu Glu Ala Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala  
 545 550 555 560  
 Ala Val Glu Lys Leu Asn Thr Glu Ser Gln Glu Met Gly Lys Ala Ile  
 565 570 575  
 Tyr Glu Ala Asp Ala Ala Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala  
 580 585 590  
 Glu Gly Ala Ala Asp Asp Asn Val Val Asp Ala Glu Val Val Glu Asp  
 595 600 605  
 Asp Ala Ala Asp Asn Gly Glu Asp Lys Lys  
 610 615

<210> 33  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1954)  
 <223> FRXA02543

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 Met Gly Arg Ala Val  
 1 5  
 gga att gac ctt gga acc acc aac tct gtg gtt tcc gta ctt gaa ggc 163  
 Gly Ile Asp Leu Gly Thr Thr Asn Ser Val Val Ser Val Leu Glu Gly  
 10 15 20  
 ggc gag cca gta gtt atc gca aac gca gaa ggc tca cgc acc acc cct 211  
 Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly Ser Arg Thr Thr Pro  
 25 30 35

tcc gtc gtt gca ttc gca aag aac ggt gaa gtt cta gtc ggc cag tcc	259
Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val Leu Val Gly Gln Ser	
40 45 50	
gct aag aac cag gcg gtc acc aac gtt gac cgc acc att cgc tcc gtc	307
Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg Thr Ile Arg Ser Val	
55 60 65	
aag cgc cac atc ggc acc gac tgg tcc gtt gct atc gat gac aag aac	355
Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala Ile Asp Asp Lys Asn	
70 75 80 85	
tac acc tca cag gaa atc tcg gct cgt acc ctg atg aag ctg aag cgc	403
Tyr Thr Ser Gln Glu Ile Ser Ala Arg Thr Leu Met Lys Leu Lys Arg	
90 95 100	
gac gct gaa gca tac ctg ggc gag gac gtc act gat gct gtt att acc	451
Asp Ala Glu Ala Tyr Leu Gly Glu Asp Val Thr Asp Ala Val Ile Thr	
105 110 115	
gtt cct gca tac ttc gag gac tca cag cgc cag gca acc aag gaa gct	499
Val Pro Ala Tyr Phe Glu Asp Ser Gln Arg Gln Ala Thr Lys Glu Ala	
120 125 130	
ggt cag atc gca ggc ctt aac gtt ctg cgt att gtt aac gag cca acc	547
Gly Gln Ile Ala Gly Leu Asn Val Leu Arg Ile Val Asn Glu Pro Thr	
135 140 145	
gcg gct gca ctt gca tac ggc ctt gag aag ggc gag cag gag cag acc	595
Ala Ala Ala Leu Ala Tyr Gly Leu Glu Lys Gly Glu Gln Glu Gln Thr	
150 155 160 165	
att ctg gta ttc gac ctc ggt ggc ggc acc ttc gac gtc tcc ctc cta	643
Ile Leu Val Phe Asp Leu Gly Gly Gly Thr Phe Asp Val Ser Leu Leu	
170 175 180	
gag atc ggc gac ggt gtt gtt gag gtt cgc gca acc tcc ggc gat aac	691
Glu Ile Gly Asp Gly Val Val Glu Val Arg Ala Thr Ser Gly Asp Asn	
185 190 195	
gag ctc ggt ggc gac gac tgg gat cag cgt atc gtt gac tgg ctg gta	739
Glu Leu Gly Gly Asp Asp Trp Asp Gln Arg Ile Val Asp Trp Leu Val	
200 205 210	
gag aag ttc cag tcc tcc aac ggc att gac ctg acc aag gac aag atg	787
Glu Lys Phe Gln Ser Ser Asn Gly Ile Asp Leu Thr Lys Asp Lys Met	
215 220 225	
gcc ctg cag cgt ctg cgt gag gca gct gag aag gca aag atc gag ctg	835
Ala Leu Gln Arg Leu Arg Glu Ala Ala Glu Lys Ala Lys Ile Glu Leu	
230 235 240 245	
tcc tct tcc cag agt gca aac atc aac ctt cct tac atc acc gtt gat	883
Ser Ser Ser Gln Ser Ala Asn Ile Asn Leu Pro Tyr Ile Thr Val Asp	
250 255 260	
gca gac aag aac cca ctg ttc ttg gat gag acc ctt tcc cgt gcc gag	931

Ala Asp Lys Asn Pro Leu Phe Leu Asp Glu Thr Leu Ser Arg Ala Glu	
265 270 275	
ttc cag cgc atc acc cag gac ctc ctg gcc cgc acc aag act cct ttc	979
Phe Gln Arg Ile Thr Gln Asp Leu Leu Ala Arg Thr Lys Thr Pro Phe	
280 285 290	
aac cag gtt gtt aag gac gct ggc gtg tcc gtc tcg gag atc gac cac	1027
Asn Gln Val Val Lys Asp Ala Gly Val Ser Val Ser Glu Ile Asp His	
295 300 305	
gtt gtt ctc gtc ggt ggt tcc acc cgt atg cct gct gtt acc gaa ctg	1075
Val Val Leu Val Gly Gly Ser Thr Arg Met Pro Ala Val Thr Glu Leu	
310 315 320 325	
gtc aag gaa ctg acc ggt gga cgt gag cca aac aag ggt gtt aac cca	1123
Val Lys Glu Leu Thr Gly Gly Arg Glu Pro Asn Lys Gly Val Asn Pro	
330 335 340	
gat gag gtt gtt gca gtt ggt gca gca ctt cag gcc ggt gtt ctc cgc	1171
Asp Glu Val Val Ala Val Gly Ala Ala Leu Gln Ala Gly Val Leu Arg	
345 350 355	
ggc gag gtc aag gat gtt ctt ctt ctt gac gtc acc cca ctg tcc ctc	1219
Gly Glu Val Lys Asp Val Leu Leu Leu Asp Val Thr Pro Leu Ser Leu	
360 365 370	
ggc att gag acc aag ggt ggc gtg atg acc aag ctc atc gag cgc aac	1267
Gly Ile Glu Thr Lys Gly Gly Val Met Thr Lys Leu Ile Glu Arg Asn	
375 380 385	
acc acc atc cct acc aag cgt tcc gag acc ttc acc acc gca gag gac	1315
Thr Thr Ile Pro Thr Lys Arg Ser Glu Thr Phe Thr Thr Ala Glu Asp	
390 395 400 405	
aac cag cct tct gtt cag atc cag gtc ttc cag ggc gag cgt gaa atc	1363
Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln Gly Glu Arg Glu Ile	
410 415 420	
gca acc gcc aac aag ctg ctc gga tcc ttc gag ctc ggc ggc atc gca	1411
Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu Leu Gly Gly Ile Ala	
425 430 435	
cct gca cca cgt ggc gtc cca cag atc gag gtc act ttc gac atc gac	1459
Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val Thr Phe Asp Ile Asp	
440 445 450	
gcc aac ggc atc gtc cac gtc acc gca aag gac aag ggt act ggc aag	1507
Ala Asn Gly Ile Val His Val Thr Ala Lys Asp Lys Gly Thr Gly Lys	
455 460 465	
gaa aac acc atc acc att cag gac ggc tcc ggt ctc tcc cag gat gaa	1555
Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly Leu Ser Gln Asp Glu	
470 475 480 485	
att gat cgc atg atc aag gat gct gaa gct cac gct gat gag gac aag	1603
Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His Ala Asp Glu Asp Lys	



490	495	500	
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tac cag acc cgc aag ttc gtt gaa gag aac tcc gag aag gtc tcc gaa Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser Glu Lys Val Ser Glu 520 525 530			1699
gac ctc aag gca aag gtc gaa gag gca gcc aag ggc gtt gaa gaa gca Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys Gly Val Glu Glu Ala 535 540 545			1747
ctc aag ggc gag gac ctc gag gca atc aag gct gca gtt gag aag ctg Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala Ala Val Glu Lys Leu 550 555 560 565			1795
aac acc gag tcc cag gaa atg ggt aag gnt atc tnc gag gct gac gct Asn Thr Glu Ser Gln Glu Met Gly Lys Xaa Ile Xaa Glu Ala Asp Ala 570 575 580			1843
nct gct ggt gca acc cag gct gac gca ggt gca gaa ggc gct gca gat Xaa Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala Glu Gly Ala Ala Asp 585 590 595			1891
gac aat gtt gtt gac gct gaa gtt gtc gaa gac gac gca gct gac aat Asp Asn Val Val Asp Ala Glu Val Val Glu Asp Asp Ala Ala Asp Asn 600 605 610			1939
ggt gag gac aag aag taaatgacta cccctaacgg aat Gly Glu Asp Lys Lys 615			1977

&lt;210&gt; 34

&lt;211&gt; 618

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 34

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Ser Val Leu Glu Gly Gly Glu Pro Val Val Ile Ala Asn Ala Glu Gly 20 25 30
Ser Arg Thr Thr Pro Ser Val Val Ala Phe Ala Lys Asn Gly Glu Val 35 40 45
Leu Val Gly Gln Ser Ala Lys Asn Gln Ala Val Thr Asn Val Asp Arg 50 55 60
Thr Ile Arg Ser Val Lys Arg His Ile Gly Thr Asp Trp Ser Val Ala 65 70 75 80
Ile Asp Asp Lys Asn Tyr Thr Ser Gln Glu Ile Ser Ala Arg Thr Leu

85										90					95				
Met	Lys	Leu	Lys	Arg	Asp	Ala	Glu	Ala	Tyr	Leu	Gly	Glu	Asp	Val	Thr				
			100					105					110						
Asp	Ala	Val	Ile	Thr	Val	Pro	Ala	Tyr	Phe	Glu	Asp	Ser	Gln	Arg	Gln				
		115					120					125							
Ala	Thr	Lys	Glu	Ala	Gly	Gln	Ile	Ala	Gly	Leu	Asn	Val	Leu	Arg	Ile				
		130				135					140								
Val	Asn	Glu	Pro	Thr	Ala	Ala	Ala	Leu	Ala	Tyr	Gly	Leu	Glu	Lys	Gly				
145					150				155						160				
Glu	Gln	Glu	Gln	Thr	Ile	Leu	Val	Phe	Asp	Leu	Gly	Gly	Gly	Thr	Phe				
				165					170					175					
Asp	Val	Ser	Leu	Leu	Glu	Ile	Gly	Asp	Gly	Val	Val	Glu	Val	Arg	Ala				
			180					185					190						
Thr	Ser	Gly	Asp	Asn	Glu	Leu	Gly	Gly	Asp	Asp	Trp	Asp	Gln	Arg	Ile				
		195					200					205							
Val	Asp	Trp	Leu	Val	Glu	Lys	Phe	Gln	Ser	Ser	Asn	Gly	Ile	Asp	Leu				
	210					215					220								
Thr	Lys	Asp	Lys	Met	Ala	Leu	Gln	Arg	Leu	Arg	Glu	Ala	Ala	Glu	Lys				
225					230					235					240				
Ala	Lys	Ile	Glu	Leu	Ser	Ser	Ser	Gln	Ser	Ala	Asn	Ile	Asn	Leu	Pro				
				245					250					255					
Tyr	Ile	Thr	Val	Asp	Ala	Asp	Lys	Asn	Pro	Leu	Phe	Leu	Asp	Glu	Thr				
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Leu	Ser	Arg	Ala	Glu	Phe	Gln	Arg	Ile	Thr	Gln	Asp	Leu	Leu	Ala	Arg				
		275					280					285							
Thr	Lys	Thr	Pro	Phe	Asn	Gln	Val	Val	Lys	Asp	Ala	Gly	Val	Ser	Val				
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Ser	Glu	Ile	Asp	His	Val	Val	Leu	Val	Gly	Gly	Ser	Thr	Arg	Met	Pro				
305					310					315					320				
Ala	Val	Thr	Glu	Leu	Val	Lys	Glu	Leu	Thr	Gly	Gly	Arg	Glu	Pro	Asn				
				325					330					335					
Lys	Gly	Val	Asn	Pro	Asp	Glu	Val	Val	Ala	Val	Gly	Ala	Ala	Leu	Gln				
			340					345					350						
Ala	Gly	Val	Leu	Arg	Gly	Glu	Val	Lys	Asp	Val	Leu	Leu	Leu	Asp	Val				
		355				360						365							
Thr	Pro	Leu	Ser	Leu	Gly	Ile	Glu	Thr	Lys	Gly	Gly	Val	Met	Thr	Lys				
		370				375					380								
Leu	Ile	Glu	Arg	Asn	Thr	Thr	Ile	Pro	Thr	Lys	Arg	Ser	Glu	Thr	Phe				

385		390		395		400
Thr Thr Ala Glu Asp Asn Gln Pro Ser Val Gln Ile Gln Val Phe Gln						
		405		410		415
Gly Glu Arg Glu Ile Ala Thr Ala Asn Lys Leu Leu Gly Ser Phe Glu						
		420		425		430
Leu Gly Gly Ile Ala Pro Ala Pro Arg Gly Val Pro Gln Ile Glu Val						
		435		440		445
Thr Phe Asp Ile Asp Ala Asn Gly Ile Val His Val Thr Ala Lys Asp						
		450		455		460
Lys Gly Thr Gly Lys Glu Asn Thr Ile Thr Ile Gln Asp Gly Ser Gly						
		465		470		480
Leu Ser Gln Asp Glu Ile Asp Arg Met Ile Lys Asp Ala Glu Ala His						
		485		490		495
Ala Asp Glu Asp Lys Lys Arg Arg Glu Glu Gln Glu Val Arg Asn Asn						
		500		505		510
Ala Glu Ser Leu Val Tyr Gln Thr Arg Lys Phe Val Glu Glu Asn Ser						
		515		520		525
Glu Lys Val Ser Glu Asp Leu Lys Ala Lys Val Glu Glu Ala Ala Lys						
		530		535		540
Gly Val Glu Glu Ala Leu Lys Gly Glu Asp Leu Glu Ala Ile Lys Ala						
		545		550		560
Ala Val Glu Lys Leu Asn Thr Glu Ser Gln Glu Met Gly Lys Xaa Ile						
		565		570		575
Xaa Glu Ala Asp Ala Xaa Ala Gly Ala Thr Gln Ala Asp Ala Gly Ala						
		580		585		590
Glu Gly Ala Ala Asp Asp Asn Val Val Asp Ala Glu Val Val Glu Asp						
		595		600		605
Asp Ala Ala Asp Asn Gly Glu Asp Lys Lys						
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<210> 35  
 <211> 1947  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1924)  
 <223> RXN02280

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	Met Gln Glu Ser Ser	
	1 5	
cgat gat aat ttc caa gtt gac ctc ggc ggc gtt gtt gat ctt ttg agt	163	
Arg Asp Asn Phe Gln Val Asp Leu Gly Gly Val Val Asp Leu Leu Ser		
	10 15 20	
cgc cac att tat tcc ggt ccg agg gtg tat gtg cgt gag ttg ctg cag	211	
Arg His Ile Tyr Ser Gly Pro Arg Val Tyr Val Arg Glu Leu Leu Gln		
	25 30 35	
aat gcg gtt gat gct tgt act gca cgt tct gaa cag ggt gag gag ggc	259	
Asn Ala Val Asp Ala Cys Thr Ala Arg Ser Glu Gln Gly Glu Glu Gly		
	40 45 50	
tac gag ccg agt att cgt att ccg ccg gtg acc aag gat cgt gcc acg	307	
Tyr Glu Pro Ser Ile Arg Ile Arg Pro Val Thr Lys Asp Arg Ala Thr		
	55 60 65	
ttt tca ctg gtt gat aat ggt acg ggc ctg acc gcg cag gag gcg cgg	355	
Phe Ser Leu Val Asp Asn Gly Thr Gly Leu Thr Ala Gln Glu Ala Arg		
	70 75 80 85	
gaa ttg ctg gcg acg gtg ggg ccg acg tcg aaa cgc gat gaa ttc ggt	403	
Glu Leu Leu Ala Thr Val Gly Arg Thr Ser Lys Arg Asp Glu Phe Gly		
	90 95 100	
ctg cag ccg gaa ggt cgc ctg ggg caa ttt ggc atc ggg ctg ctt agt	451	
Leu Gln Arg Glu Gly Arg Leu Gly Gln Phe Gly Ile Gly Leu Leu Ser		
	105 110 115	
tgt ttc atg gtg gcg gat gag atc acc atg gtg tcg cat gcg gag ggt	499	
Cys Phe Met Val Ala Asp Glu Ile Thr Met Val Ser His Ala Glu Gly		
	120 125 130	
gcg tcg gcg att ccg tgg act ggt cat gcg gat ggc acc ttt aac ctg	547	
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Glu Ile Leu Gly Asp Asp Ala Thr Asp Val Ile Pro Val Gly Thr Thr		
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Val His Leu Thr Pro Arg Pro Asp Glu Arg Thr Leu Leu Thr Glu Asn		
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Ser Val Val Thr Ile Ala Ser Asn Tyr Gly Arg Tyr Leu Pro Ile Pro		
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Ile Val Val Gln Gly Glu Lys Asn Thr Thr Ile Thr Thr Ser Pro Val		
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Phe Ala Lys Asp Thr Asp Gln Gln His Arg Leu Tyr Ala Gly Arg Glu	
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Arg Leu Gly Lys Thr Pro Phe Asp Val Ile Asp Leu Thr Gly Pro Gly	
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Ile Glu Gly Val Ala Tyr Val Leu Pro Glu Ala Gln Ala Pro His Met	
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Ser Arg Arg His Ser Ile Tyr Val Asn Arg Met Leu Val Ser Asp Gly	
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Pro Ser Thr Val Leu Pro Asn Trp Ala Phe Phe Val Glu Cys Glu Ile	
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Asn Ser Thr Asp Leu Glu Pro Thr Ala Ser Arg Glu Ala Leu Met Asp	
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Asp Thr Ala Phe Ala Ala Thr Arg Glu His Ile Gly Glu Cys Ile Lys	
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Phe Thr Ala Ile His Asp Leu Ala Leu Arg Glu Leu Cys Gln Ser Asp	
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Ala Asp Leu Ala Glu Thr Met Leu Gly Leu Leu Thr Leu Glu Thr Ser	
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Arg Gly Arg Ile Ser Ile Gly Glu Ile Thr Thr Leu Ser Ile Thr Glu	
375 380 385	
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Asp Val Ser Leu Gln Leu Ala Thr Thr Leu Asp Asp Phe Arg Gln Leu	
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Asn Thr Ile Ala Arg Pro Asp Thr Leu Ile Ile Asn Gly Gly Tyr Ile	
410 415 420	
cac gac agc gat ctg gct cgg ctc att ccc gtt cac tac cca ccg ctt	1411
His Asp Ser Asp Leu Ala Arg Leu Ile Pro Val His Tyr Pro Pro Leu	
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Thr Val Ser Thr Ala Asp Leu Arg Glu Ser Met Asp Leu Met Glu Leu  
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 Thr Glu Ser Leu Lys Asp Phe Gln Ile Lys Gly Ala Thr Arg Val Phe  
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 Glu Pro Ala Asp Val Pro Ala Val Val Ile Ile Asp Ser Lys Ala Gln  
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 Ala Ser Arg Asp Arg Asn Glu Thr Gln Ser Ala Thr Thr Asp Arg Trp  
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 Lys Asp Arg Ala Thr Phe Ser Leu Val Asp Asn Gly Thr Gly Leu Thr  
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 Pro Val Gly Thr Thr Val His Leu Thr Pro Arg Pro Asp Glu Arg Thr  
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 Tyr Leu Pro Ile Pro Ile Val Val Gln Gly Glu Lys Asn Thr Thr Ile  
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 Thr Thr Ser Pro Val Phe Ala Lys Asp Thr Asp Gln Gln His Arg Leu  
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 Tyr Ala Gly Arg Glu Arg Leu Gly Lys Thr Pro Phe Asp Val Ile Asp  
 225 230 235 240  
 Leu Thr Gly Pro Gly Ile Glu Gly Val Ala Tyr Val Leu Pro Glu Ala  
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 Gln Ala Pro His Met Ser Arg Arg His Ser Ile Tyr Val Asn Arg Met  
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 Gly Glu Cys Ile Lys Ser Trp Leu Ile Asn Leu Ala Met Thr Lys Pro  
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His Arg Val Arg Glu Phe Thr Ala Ile His Asp Leu Ala Leu Arg Glu  
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 Thr Leu Glu Thr Ser Arg Gly Arg Ile Ser Ile Gly Glu Ile Thr Thr  
 370 375 380  
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 385 390 395 400  
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 405 410 415  
 Asn Gly Gly Tyr Ile His Asp Ser Asp Leu Ala Arg Leu Ile Pro Val  
 420 425 430  
 His Tyr Pro Pro Leu Thr Val Ser Thr Ala Asp Leu Arg Glu Ser Met  
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 Asp Leu Met Glu Leu Pro Pro Leu Gln Asp Ile Glu Lys Ala Lys Ala  
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 Ala Thr Arg Val Phe Glu Pro Ala Asp Val Pro Ala Val Val Ile Ile  
 485 490 495  
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Arg His Ile Tyr Ser Gly Pro Arg Val Tyr Val Arg Glu Leu Leu Gln
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Tyr Glu Pro Ser Ile Arg Ile Arg Pro Val Thr Lys Asp Arg Ala Thr
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Cys	His	Gly	Ser	Gly	Ser	Ala	Ser	Asp	Lys	Lys	Pro	Val	Thr	Cys	Gly		
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cgt	gct	cgc	cgc	gac	atc	gtg	gcc	aac	atc	cca	gct	ggc	atc	cag	tcc	787	
Arg	Ala	Arg	Arg	Asp	Ile	Val	Ala	Asn	Ile	Pro	Ala	Gly	Ile	Gln	Ser		
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Ile	Phe	Thr	Arg	Asp	Gly	Asp	Asp	Leu	His	Ala	Ser	Ile	Lys	Val	Pro		
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His Gly Asn Leu Met Ala His Val Asp Leu Phe Val Pro Thr Asp Leu				
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Asp Asp Arg Thr Arg Glu Leu Leu Glu Glu Ile Arg Asn His Arg Ser				
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Asp Asn Ala Ser Val His Arg Glu Gly Gly Glu Glu Ser Gly Phe Phe				
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 Asp Ala Phe Phe Gly Gly Gly Ala Gly Gly Ser Arg Gly Pro Arg Ser  
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 Arg Val Gln Pro Gly Ser Asp Thr Leu Trp Arg Thr Ser Ile Thr Leu  
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 Glu Glu Ala Tyr Lys Gly Ala Lys Lys Asp Leu Thr Leu Asp Thr Ala  
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 Val Leu Cys Thr Lys Cys His Gly Ser Gly Ser Ala Ser Asp Lys Lys  
 145 150 155 160

Pro Val Thr Cys Gly Thr Cys Asn Gly Ala Gly Glu Ile Gln Glu Val  
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 Cys Asp Gly Thr Gly Glu Ile Ile Pro Asp Pro Cys Thr Glu Cys Ala  
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 Val Arg Pro His Ala Ile Phe Thr Arg Asp Gly Asp Asp Leu His Ala  
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 Val Pro Thr Asp Leu Asp Asp Arg Thr Arg Glu Leu Leu Glu Glu Ile  
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Ser	Thr	Leu	Lys	Asp	His	Asn	His	Lys	Leu	Lys	Lys	Gly	Glu	Phe	Val		
	150				155				160					165			
acc	atc	aac	atc	acc	gca	agc	att	gac	ggt	gag	aag	att	gaa	gag	gca		643
Thr	Ile	Asn	Ile	Thr	Ala	Ser	Ile	Asp	Gly	Glu	Lys	Ile	Glu	Glu	Ala		
			170					175					180				
acc	act	gag	ggt	ctg	tcc	tac	gaa	atc	gga	tct	gac	gat	ctg	att	gac		691
Thr	Thr	Glu	Gly	Leu	Ser	Tyr	Glu	Ile	Gly	Ser	Asp	Asp	Leu	Ile	Asp		
		185					190						195				
ggc	ctg	gac	aag	gct	ctg	atc	ggc	gct	aag	aag	gat	gaa	acc	gta	gag		739
Gly	Leu	Asp	Lys	Ala	Leu	Ile	Gly	Ala	Lys	Lys	Asp	Glu	Thr	Val	Glu		
	200					205					210						
ttc	acc	tct	gag	ctg	gca	aac	ggc	gag	cac	aag	ggc	aag	gaa	gct	caa		787
Phe	Thr	Ser	Glu	Leu	Ala	Asn	Gly	Glu	His	Lys	Gly	Lys	Glu	Ala	Gln		

215	220	225	
atc agc gtt gag atc acc gca acc aag cag cgc gag ctg cct gag ctg Ile Ser Val Glu Ile Thr Ala Thr Lys Gln Arg Glu Leu Pro Glu Leu 230 235 240 245			835
gat gat gag ttc gca cag ctg gct tct gag ttc gac acc atc gaa gag Asp Asp Glu Phe Ala Gln Leu Ala Ser Glu Phe Asp Thr Ile Glu Glu 250 255 260			883
ctt cgt gag tcc acc gtg tct gac gtt gag gct aag cag aag aac gag Leu Arg Glu Ser Thr Val Ser Asp Val Glu Ala Lys Gln Lys Asn Glu 265 270 275			931
cag gct gct gca atc cgc gac gaa gtt ctc gct gcg gct ctt ggc gag Gln Ala Ala Ala Ile Arg Asp Glu Val Leu Ala Ala Ala Leu Gly Glu 280 285 290			979
gct gac ttc gct ctg cca cag tcc atc gtt gac gag cag gca cac tcc Ala Asp Phe Ala Leu Pro Gln Ser Ile Val Asp Glu Gln Ala His Ser 295 300 305			1027
cag ctg cac cag ctc ctc ggc gag ctt gca cac gac gat gct gca ctg Gln Leu His Gln Leu Leu Gly Glu Leu Ala His Asp Asp Ala Ala Leu 310 315 320 325			1075
aac tcc ctc ctt gag gct cag ggc acc act cgt gaa gag ttc gac aag Asn Ser Leu Leu Glu Ala Gln Gly Thr Thr Arg Glu Glu Phe Asp Lys 330 335 340			1123
aag aac gtc gaa gat gct gag aag gct gtt cgc acc cag ctg ttc ctg Lys Asn Val Glu Asp Ala Glu Lys Ala Val Arg Thr Gln Leu Phe Leu 345 350 355			1171
gac acc ctc tct gag gtt gag gag cct gag gtt tcc cag cag gag ctc Asp Thr Leu Ser Glu Val Glu Glu Pro Glu Val Ser Gln Gln Glu Leu 360 365 370			1219
acc gac cac atc ctg ttc acc gca cag tct tac ggc atg gac cca aac Thr Asp His Ile Leu Phe Thr Ala Gln Ser Tyr Gly Met Asp Pro Asn 375 380 385			1267
cag ttc atc ggt cag ctg cag cag tcc ggc cag atc gcg aac ctc ttc Gln Phe Ile Gly Gln Leu Gln Gln Ser Gly Gln Ile Ala Asn Leu Phe 390 395 400 405			1315
tcc gac gtt cgc cgt ggc aag gct ctt gca cag gct atc tgc cgc gta Ser Asp Val Arg Arg Gly Lys Ala Leu Ala Gln Ala Ile Cys Arg Val 410 415 420			1363
aac gtg aag gac tcc gag ggt aac gag atc gac cct aag gaa tac ttc Asn Val Lys Asp Ser Glu Gly Asn Glu Ile Asp Pro Lys Glu Tyr Phe 425 430 435			1411
ggt gaa gaa gaa gta gct gag act gag tct gaa gct taaaaacttt Gly Glu Glu Glu Val Ala Glu Thr Glu Ser Glu Ala 440 445			1457



aaagaaataa cgc

1470

&lt;210&gt; 42

&lt;211&gt; 449

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 42

Val	Lys	Ser	Ser	Val	Glu	Lys	Leu	Ser	Asp	Thr	Arg	Ser	Lys	Ile	Thr
1				5					10					15	

Val	Glu	Val	Pro	Phe	Ser	Glu	Leu	Lys	Pro	Glu	Ile	Asp	Gln	Ala	Tyr
			20					25					30		

Ala	Ala	Leu	Ala	Gln	Gln	Val	Gln	Ile	Pro	Gly	Phe	Arg	Lys	Gly	Lys
		35					40					45			

Ala	Pro	Arg	Gln	Leu	Ile	Asp	Ala	Arg	Phe	Gly	Arg	Gly	Ala	Val	Leu
	50					55					60				

Glu	Gln	Val	Val	Asn	Asp	Met	Leu	Pro	Asn	Arg	Tyr	Ala	Gln	Ala	Ile
65				70						75					80

Glu	Ala	Glu	Gly	Ile	Lys	Ala	Ile	Gly	Gln	Pro	Asn	Val	Glu	Val	Thr
				85					90					95	

Lys	Ile	Glu	Asp	Asn	Glu	Leu	Val	Glu	Phe	Val	Ala	Glu	Val	Asp	Val
			100					105					110		

Arg	Pro	Glu	Phe	Glu	Leu	Pro	Lys	Phe	Glu	Asp	Ile	Thr	Val	Glu	Val
		115					120					125			

Pro	Ala	Ile	Lys	Ala	Asp	Glu	Glu	Ala	Ile	Glu	Ala	Glu	Leu	Glu	Thr
	130					135					140				

Leu	Arg	Ala	Arg	Phe	Ser	Thr	Leu	Lys	Asp	His	Asn	His	Lys	Leu	Lys
145					150					155					160

Lys	Gly	Glu	Phe	Val	Thr	Ile	Asn	Ile	Thr	Ala	Ser	Ile	Asp	Gly	Glu
				165					170					175	

Lys	Ile	Glu	Glu	Ala	Thr	Thr	Glu	Gly	Leu	Ser	Tyr	Glu	Ile	Gly	Ser
			180					185					190		

Asp	Asp	Leu	Ile	Asp	Gly	Leu	Asp	Lys	Ala	Leu	Ile	Gly	Ala	Lys	Lys
		195				200						205			

Asp	Glu	Thr	Val	Glu	Phe	Thr	Ser	Glu	Leu	Ala	Asn	Gly	Glu	His	Lys
	210					215					220				

Gly	Lys	Glu	Ala	Gln	Ile	Ser	Val	Glu	Ile	Thr	Ala	Thr	Lys	Gln	Arg
225				230						235					240

Glu	Leu	Pro	Glu	Leu	Asp	Asp	Glu	Phe	Ala	Gln	Leu	Ala	Ser	Glu	Phe
				245					250					255	

Asp Thr Ile Glu Glu Leu Arg Glu Ser Thr Val Ser Asp Val Glu Ala  
 260 265 270  
 Lys Gln Lys Asn Glu Gln Ala Ala Ala Ile Arg Asp Glu Val Leu Ala  
 275 280 285  
 Ala Ala Leu Gly Glu Ala Asp Phe Ala Leu Pro Gln Ser Ile Val Asp  
 290 295 300  
 Glu Gln Ala His Ser Gln Leu His Gln Leu Leu Gly Glu Leu Ala His  
 305 310 315 320  
 Asp Asp Ala Ala Leu Asn Ser Leu Leu Glu Ala Gln Gly Thr Thr Arg  
 325 330 335  
 Glu Glu Phe Asp Lys Lys Asn Val Glu Asp Ala Glu Lys Ala Val Arg  
 340 345 350  
 Thr Gln Leu Phe Leu Asp Thr Leu Ser Glu Val Glu Glu Pro Glu Val  
 355 360 365  
 Ser Gln Gln Glu Leu Thr Asp His Ile Leu Phe Thr Ala Gln Ser Tyr  
 370 375 380  
 Gly Met Asp Pro Asn Gln Phe Ile Gly Gln Leu Gln Gln Ser Gly Gln  
 385 390 395 400  
 Ile Ala Asn Leu Phe Ser Asp Val Arg Arg Gly Lys Ala Leu Ala Gln  
 405 410 415  
 Ala Ile Cys Arg Val Asn Val Lys Asp Ser Glu Gly Asn Glu Ile Asp  
 420 425 430  
 Pro Lys Glu Tyr Phe Gly Glu Glu Glu Val Ala Glu Thr Glu Ser Glu  
 435 440 445

Ala

<210> 43  
 <211> 826  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <223> RXN03038

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 ccaaacacgt tcaaatccgt taaagtcct gtttaaaact atg cat tca aag gaa 115  
 Met His Ser Lys Glu  
 1 5

gag tta aca gtg cgt aaa gga att tcc cgc gtc ctc tcg gta gcg gtt	163
Glu Leu Thr Val Arg Lys Gly Ile Ser Arg Val Leu Ser Val Ala Val	
10 15 20	
gct agt tca atc gga ttc gga act gta ctg aca ggc acc ggc atc gca	211
Ala Ser Ser Ile Gly Phe Gly Thr Val Leu Thr Gly Thr Gly Ile Ala	
25 30 35	
gca gct caa gac tct gca ttt gac tac ggt atg gat cca aac atg aac	259
Ala Ala Gln Asp Ser Ala Phe Asp Tyr Gly Met Asp Pro Asn Met Asn	
40 45 50	
tac aac ccg atc gat gac atc aag gat cgt ccc gaa gga ttg tcc aat	307
Tyr Asn Pro Ile Asp Asp Ile Lys Asp Arg Pro Glu Gly Leu Ser Asn	
55 60 65	
ctt ccc tac ttc gga agt aaa ttg acc agc tgg ggc tca tca tat gcc	355
Leu Pro Tyr Phe Gly Ser Lys Leu Thr Ser Trp Gly Ser Ser Tyr Ala	
70 75 80 85	
acc gcc tca tcc ggc gtc gtg acc tcc gcg ctc ccg cag tac acc gat	403
Thr Ala Ser Ser Gly Val Val Thr Ser Ala Leu Pro Gln Tyr Thr Asp	
90 95 100	
ccg cgc tac ccc ctc ggc aaa gac gac ctg ccc aag gca acc atc gac	451
Pro Arg Tyr Pro Leu Gly Lys Asp Asp Leu Pro Lys Ala Thr Ile Asp	
105 110 115	
atg gag cca gaa gtt ctt gcg cgc ctt gag cga ttc gtc ggc gtt gac	499
Met Glu Pro Glu Val Leu Ala Arg Leu Glu Arg Phe Val Gly Val Asp	
120 125 130	
ggt gat cgc atc cgc caa atc aac gcg tac tcg cca tca atg gga cgc	547
Gly Asp Arg Ile Arg Gln Ile Asn Ala Tyr Ser Pro Ser Met Gly Arg	
135 140 145	
acc att cct cta gtc tgg gtt gtt cca gaa gac aac acc gtg cct ggc	595
Thr Ile Pro Leu Val Trp Val Val Pro Glu Asp Asn Thr Val Pro Gly	
150 155 160 165	
cca acg gtc tac gca ctc gga ggc ggt gac ggt gga caa ggc ggc cag	643
Pro Thr Val Tyr Ala Leu Gly Gly Gly Asp Gly Gly Gln Gly Gly Gln	
170 175 180	
aac tgg gtc acc cgc acc gac ctt gag gaa tta acc agt gac aac aac	691
Asn Trp Val Thr Arg Thr Asp Leu Glu Glu Leu Thr Ser Asp Asn Asn	
185 190 195	
atc aac ctc atc atg ccg atg ctc gga tct ttt agt ttc tac tct gac	739
Ile Asn Leu Ile Met Pro Met Leu Gly Ser Phe Ser Phe Tyr Ser Asp	
200 205 210	
tgg gca cgc gaa agc caa tcc atg ggt tgt gcg caa cag tgg gaa aca	787
Trp Ala Arg Glu Ser Gln Ser Met Gly Cys Ala Gln Gln Trp Glu Thr	
215 220 225	

ttg ctc atg cac gaa ctg cct gag ccg ctt gta gcg gcc  
 Leu Leu Met His Glu Leu Pro Glu Pro Leu Val Ala Ala  
 230 235 240

826

<210> 44  
 <211> 242  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 44

Met His Ser Lys Glu Glu Leu Thr Val Arg Lys Gly Ile Ser Arg Val  
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 Leu Ser Val Ala Val Ala Ser Ser Ile Gly Phe Gly Thr Val Leu Thr  
 20 25 30  
 Gly Thr Gly Ile Ala Ala Ala Gln Asp Ser Ala Phe Asp Tyr Gly Met  
 35 40 45  
 Asp Pro Asn Met Asn Tyr Asn Pro Ile Asp Asp Ile Lys Asp Arg Pro  
 50 55 60  
 Glu Gly Leu Ser Asn Leu Pro Tyr Phe Gly Ser Lys Leu Thr Ser Trp  
 65 70 75 80  
 Gly Ser Ser Tyr Ala Thr Ala Ser Ser Gly Val Val Thr Ser Ala Leu  
 85 90 95  
 Pro Gln Tyr Thr Asp Pro Arg Tyr Pro Leu Gly Lys Asp Asp Leu Pro  
 100 105 110  
 Lys Ala Thr Ile Asp Met Glu Pro Glu Val Leu Ala Arg Leu Glu Arg  
 115 120 125  
 Phe Val Gly Val Asp Gly Asp Arg Ile Arg Gln Ile Asn Ala Tyr Ser  
 130 135 140  
 Pro Ser Met Gly Arg Thr Ile Pro Leu Val Trp Val Val Pro Glu Asp  
 145 150 155 160  
 Asn Thr Val Pro Gly Pro Thr Val Tyr Ala Leu Gly Gly Gly Asp Gly  
 165 170 175  
 Gly Gln Gly Gly Gln Asn Trp Val Thr Arg Thr Asp Leu Glu Glu Leu  
 180 185 190  
 Thr Ser Asp Asn Asn Ile Asn Leu Ile Met Pro Met Leu Gly Ser Phe  
 195 200 205  
 Ser Phe Tyr Ser Asp Trp Ala Arg Glu Ser Gln Ser Met Gly Cys Ala  
 210 215 220  
 Gln Gln Trp Glu Thr Leu Leu Met His Glu Leu Pro Glu Pro Leu Val  
 225 230 235 240  
 Ala Ala

<210> 45  
 <211> 653  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (1)..(630)  
 <223> RXN03039

<400> 45

gca ctc ccg caa tac acc gac cca cgc tac ccc ctc ggc aaa gac gac	48
Ala Leu Pro Gln Tyr Thr Asp Pro Arg Tyr Pro Leu Gly Lys Asp Asp	
1 5 10 15	
ctg ccc aaa gca acc atc gac atg gag cca gaa gct ctt gcg cgc ctt	96
Leu Pro Lys Ala Thr Ile Asp Met Glu Pro Glu Ala Leu Ala Arg Leu	
20 25 30	
gag cga ttc gtc ggc gtt gac ggt gat cgc atc cgc caa atc aac gcg	144
Glu Arg Phe Val Gly Val Asp Gly Asp Arg Ile Arg Gln Ile Asn Ala	
35 40 45	
tac tcg cca tca atg gga cgc acc att cct cta gtc tgg gtc gtg cca	192
Tyr Ser Pro Ser Met Gly Arg Thr Ile Pro Leu Val Trp Val Val Pro	
50 55 60	
gaa gac aac acc gtg cct ggc cca acg gtc tac gca ctc ggc ggc ggc	240
Glu Asp Asn Thr Val Pro Gly Pro Thr Val Tyr Ala Leu Gly Gly Gly	
65 70 75 80	
gac ggt ggc caa ggc ggc caa aac tgg gtc acc cgc acc gac ctt gat	288
Asp Gly Gly Gln Gly Gly Gln Asn Trp Val Thr Arg Thr Asp Leu Asp	
85 90 95	
gag ttg acc agt gaa aac aac atc aac ctc atc atg ccc atg ctc gga	336
Glu Leu Thr Ser Glu Asn Asn Ile Asn Leu Ile Met Pro Met Leu Gly	
100 105 110	
tct ttt agt ttc tac gct gac tgg gca ggc gaa agc gaa tcc atg ggt	384
Ser Phe Ser Phe Tyr Ala Asp Trp Ala Gly Glu Ser Glu Ser Met Gly	
115 120 125	
ggt gcg caa cag tgg gaa aca ttc ctc atg cac gaa ctr ccm gag ccg	432
Gly Ala Gln Gln Trp Glu Thr Phe Leu Met His Glu Xaa Xaa Glu Pro	
130 135 140	
cta gaa gcg gcc atc ggc gca gac ggg caa cgc agc atc gtc ggc atg	480
Leu Glu Ala Ala Ile Gly Ala Asp Gly Gln Arg Ser Ile Val Gly Met	
145 150 155 160	
tcc atg tcc ggg gga tcr gtg ctg aac ttt gcg acg cat gac ccc aac	528
Ser Met Ser Gly Gly Xaa Val Leu Asn Phe Ala Thr His Asp Pro Asn	
165 170 175	

ttt tay tcc tck gtc ggc tca ttt tct gga tgt gcc gaa acc aac tcc 576  
 Phe Xaa Ser Xaa Val Gly Ser Phe Ser Gly Cys Ala Glu Thr Asn Ser  
                   180                                  185                                  190

tgg atg ggr cgc cgn tgg cat cgc agc cac tgc cta caa cgg caa tgt 624  
 Trp Met Xaa Arg Arg Trp His Arg Ser His Cys Leu Gln Arg Gln Cys  
                   195                                  200                                  205

cgt gcc tgagcaaatc tttggtgaag tag 653  
 Arg Ala  
           210

<210> 46  
 <211> 210  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 46  
 Ala Leu Pro Gln Tyr Thr Asp Pro Arg Tyr Pro Leu Gly Lys Asp Asp  
   1                                  5                                  10                                  15

Leu Pro Lys Ala Thr Ile Asp Met Glu Pro Glu Ala Leu Ala Arg Leu  
                   20                                  25                                  30

Glu Arg Phe Val Gly Val Asp Gly Asp Arg Ile Arg Gln Ile Asn Ala  
                   35                                  40                                  45

Tyr Ser Pro Ser Met Gly Arg Thr Ile Pro Leu Val Trp Val Val Pro  
                   50                                  55                                  60

Glu Asp Asn Thr Val Pro Gly Pro Thr Val Tyr Ala Leu Gly Gly Gly  
   65                                  70                                  75                                  80

Asp Gly Gly Gln Gly Gly Gln Asn Trp Val Thr Arg Thr Asp Leu Asp  
                                   85                                  90                                  95

Glu Leu Thr Ser Glu Asn Asn Ile Asn Leu Ile Met Pro Met Leu Gly  
                   100                                  105                                  110

Ser Phe Ser Phe Tyr Ala Asp Trp Ala Gly Glu Ser Glu Ser Met Gly  
                   115                                  120                                  125

Gly Ala Gln Gln Trp Glu Thr Phe Leu Met His Glu Xaa Xaa Glu Pro  
                   130                                  135                                  140

Leu Glu Ala Ala Ile Gly Ala Asp Gly Gln Arg Ser Ile Val Gly Met  
   145                                  150                                  155                                  160

Ser Met Ser Gly Gly Xaa Val Leu Asn Phe Ala Thr His Asp Pro Asn  
                   165                                  170                                  175

Phe Xaa Ser Xaa Val Gly Ser Phe Ser Gly Cys Ala Glu Thr Asn Ser  
                   180                                  185                                  190

Trp Met Xaa Arg Arg Trp His Arg Ser His Cys Leu Gln Arg Gln Cys



195

200

205

Arg Ala  
210

<210> 47  
<211> 432  
<212> DNA  
<213> Corynebacterium glutamicum

<220>  
<221> CDS  
<222> (101)..(409)  
<223> RXN03040

<400> 47  
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ctctacatct tcgccggttc cgggtgtgttc tctgaactag atg tca tnc ggt gac 115  
Met Ser Xaa Gly Asp  
1 5  
  
aac gca ccg att gat gag gat gcg ttc aaa aac cgc gtc ttg gtt ggg 163  
Asn Ala Pro Ile Asp Glu Asp Ala Phe Lys Asn Arg Val Leu Val Gly  
10 15 20  
  
ttt gaa atc gaa gct atg tcc aac acc tgc acc cat aac ctc aag gct 211  
Phe Glu Ile Glu Ala Met Ser Asn Thr Cys Thr His Asn Leu Lys Ala  
25 30 35  
  
gcg acc gat caa atg ggc atc gac aac atc aac tac gat ttc cga cca 259  
Ala Thr Asp Gln Met Gly Ile Asp Asn Ile Asn Tyr Asp Phe Arg Pro  
40 45 50  
  
acc gga acc cac gcc tgg gat tac tgg aac gaa gcg ctc cac cgc ttc 307  
Thr Gly Thr His Ala Trp Asp Tyr Trp Asn Glu Ala Leu His Arg Phe  
55 60 65  
  
ttc ccg ttg atg atg cag ggc ttc ggc ctc gac ggt ggt ccc atc ccg 355  
Phe Pro Leu Met Met Gln Gly Phe Gly Leu Asp Gly Gly Pro Ile Pro  
70 75 80 85  
  
atc tat aac cct aac ggt gtg acc tcc agc gag tct tct ntc aga act 403  
Ile Tyr Asn Pro Asn Gly Val Thr Ser Ser Glu Ser Ser Xaa Arg Thr  
90 95 100  
  
gtc ttc tgatgtgagc cttggcacen gtg 432  
Val Phe

<210> 48  
<211> 103  
<212> PRT  
<213> Corynebacterium glutamicum

&lt;400&gt; 48

Met Ser Xaa Gly Asp Asn Ala Pro Ile Asp Glu Asp Ala Phe Lys Asn  
 1 5 10 15

Arg Val Leu Val Gly Phe Glu Ile Glu Ala Met Ser Asn Thr Cys Thr  
 20 25 30

His Asn Leu Lys Ala Ala Thr Asp Gln Met Gly Ile Asp Asn Ile Asn  
 35 40 45

Tyr Asp Phe Arg Pro Thr Gly Thr His Ala Trp Asp Tyr Trp Asn Glu  
 50 55 60

Ala Leu His Arg Phe Phe Pro Leu Met Met Gln Gly Phe Gly Leu Asp  
 65 70 75 80

Gly Gly Pro Ile Pro Ile Tyr Asn Pro Asn Gly Val Thr Ser Ser Glu  
 85 90 95

Ser Ser Xaa Arg Thr Val Phe  
 100

&lt;210&gt; 49

&lt;211&gt; 835

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(835)

&lt;223&gt; RXN03051

&lt;400&gt; 49

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ggaactccccg ctgcctaagc gggacatagt tgcaggggac atg cgt tca gat gtt 115  
 Met Arg Ser Asp Val  
 1 5

atc gag tta ccg gag ggg gta agc aag gag aaa gct gac cag cta gaa 163  
 Ile Glu Leu Pro Glu Gly Val Ser Lys Glu Lys Ala Asp Gln Leu Glu  
 10 15 20

gtt gcg gaa gcg cga ctt aac gag ggt gca cga ctg atg gca acc acc 211  
 Val Ala Glu Ala Arg Leu Asn Glu Gly Ala Arg Leu Met Ala Thr Thr  
 25 30 35

ggg tgt gag gtt atg tgg cca acg ggc ttc tca gtt tgt ggc cga att 259  
 Gly Cys Glu Val Met Trp Pro Thr Gly Phe Ser Val Cys Gly Arg Ile  
 40 45 50

ctt gac acc tat cgc cag gtt gga ggt cag ttg tca tgg ctt ggg cca 307  
 Leu Asp Thr Tyr Arg Gln Val Gly Gly Gln Leu Ser Trp Leu Gly Pro  
 55 60 65

ccg aag tca aac gag ttg acc aat ccc gac ggt gtt ggc aaa aga agt 355

Pro Lys Ser Asn Glu Leu Thr Asn Pro Asp Gly Val Gly Lys Arg Ser  
 70 75 80 85

gaa ttt ttt ggt gga gcc atc tat tgg cac cca gac aca ggc gct tat 403  
 Glu Phe Phe Gly Gly Ala Ile Tyr Trp His Pro Asp Thr Gly Ala Tyr  
 90 95 100

gca gtg acc ttg gac ggt ttg cga cag tgg ggg acc ttg aac tgg gaa 451  
 Ala Val Thr Leu Asp Gly Leu Arg Gln Trp Gly Thr Leu Asn Trp Glu  
 105 110 115

tca ggg cca ttg ggg tac cca acc tct ggt ccg atg gat aca aac tat 499  
 Ser Gly Pro Leu Gly Tyr Pro Thr Ser Gly Pro Met Asp Thr Asn Tyr  
 120 125 130

ccc ctt act cag cga cag act ttt caa ggt ggt gac aac tac tac aac 547  
 Pro Leu Thr Gln Arg Gln Thr Phe Gln Gly Gly Asp Asn Tyr Tyr Asn  
 135 140 145

cca ttg act ggc ggt gct gtg tgg ggc gat att aaa cag cgc tac gaa 595  
 Pro Leu Thr Gly Gly Ala Val Trp Gly Asp Ile Lys Gln Arg Tyr Glu  
 150 155 160 165

gaa ctt ggc ggc tcg aat cat gcc att ggc atc ccg atc act aat gag 643  
 Glu Leu Gly Gly Ser Asn His Ala Ile Gly Ile Pro Ile Thr Asn Glu  
 170 175 180

cta cct agc ggt act gag tat ttt tac aat aat ttc tcc aat gga aca 691  
 Leu Pro Ser Gly Thr Glu Tyr Phe Tyr Asn Asn Phe Ser Asn Gly Thr  
 185 190 195

att tcg tgg cga aat gat cgt cag aca cgg ttt atg tat ttg gct acg 739  
 Ile Ser Trp Arg Asn Asp Arg Gln Thr Arg Phe Met Tyr Leu Ala Thr  
 200 205 210

cag cgg gtg tgg gat gcg ttg ggt cgg gag acg ggt cgt tta ggt ttt 787  
 Gln Arg Val Trp Asp Ala Leu Gly Arg Glu Thr Gly Arg Leu Gly Phe  
 215 220 225

cct gaa gca gat gaa aca cct gag gtt tct ggt cta ttc cat gtg gcg 835  
 Pro Glu Ala Asp Glu Thr Pro Glu Val Ser Gly Leu Phe His Val Ala  
 230 235 240 245

&lt;210&gt; 50

&lt;211&gt; 245

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 50

Met Arg Ser Asp Val Ile Glu Leu Pro Glu Gly Val Ser Lys Glu Lys  
 1 5 10 15

Ala Asp Gln Leu Glu Val Ala Glu Ala Arg Leu Asn Glu Gly Ala Arg  
 20 25 30

Leu Met Ala Thr Thr Gly Cys Glu Val Met Trp Pro Thr Gly Phe Ser

35                      40                      45  
 Val Cys Gly Arg Ile Leu Asp Thr Tyr Arg Gln Val Gly Gly Gln Leu  
     50                      55                      60  
 Ser Trp Leu Gly Pro Pro Lys Ser Asn Glu Leu Thr Asn Pro Asp Gly  
     65                      70                      75                      80  
 Val Gly Lys Arg Ser Glu Phe Phe Gly Gly Ala Ile Tyr Trp His Pro  
                     85                      90                      95  
 Asp Thr Gly Ala Tyr Ala Val Thr Leu Asp Gly Leu Arg Gln Trp Gly  
                     100                      105                      110  
 Thr Leu Asn Trp Glu Ser Gly Pro Leu Gly Tyr Pro Thr Ser Gly Pro  
                     115                      120                      125  
 Met Asp Thr Asn Tyr Pro Leu Thr Gln Arg Gln Thr Phe Gln Gly Gly  
                     130                      135                      140  
 Asp Asn Tyr Tyr Asn Pro Leu Thr Gly Gly Ala Val Trp Gly Asp Ile  
     145                      150                      155                      160  
 Lys Gln Arg Tyr Glu Glu Leu Gly Gly Ser Asn His Ala Ile Gly Ile  
                     165                      170                      175  
 Pro Ile Thr Asn Glu Leu Pro Ser Gly Thr Glu Tyr Phe Tyr Asn Asn  
                     180                      185                      190  
 Phe Ser Asn Gly Thr Ile Ser Trp Arg Asn Asp Arg Gln Thr Arg Phe  
                     195                      200                      205  
 Met Tyr Leu Ala Thr Gln Arg Val Trp Asp Ala Leu Gly Arg Glu Thr  
                     210                      215                      220  
 Gly Arg Leu Gly Phe Pro Glu Ala Asp Glu Thr Pro Glu Val Ser Gly  
     225                      230                      235                      240  
 Leu Phe His Val Ala  
                     245

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<220>  
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                     Met Lys Leu Phe Ser

1

5

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Lys Ala Ala Gly Val Ile Ala Ala Ala Leu Leu Val Ala Gly Gly Ile	
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gca cct gtg gca cag ggg caa gct agt cag gtg gtc aca cct gaa gac	211
Ala Pro Val Ala Gln Gly Gln Ala Ser Gln Val Val Thr Pro Glu Asp	
25 30 35	
caa gat gcg tat gtt caa cag ttc cac cac gaa ggg aat acc cca cct	259
Gln Asp Ala Tyr Val Gln Gln Phe His His Glu Gly Asn Thr Pro Pro	
40 45 50	
gtg gta gac ggg gtg ggt ggc tac act gag caa gaa atc gcc gag atc	307
Val Val Asp Gly Val Gly Gly Tyr Thr Glu Gln Glu Ile Ala Glu Ile	
55 60 65	
cac gag gct atc cga caa gcc caa gaa tct ggc gca cct aat gaa gag	355
His Glu Ala Ile Arg Gln Ala Gln Glu Ser Gly Ala Pro Asn Glu Glu	
70 75 80 85	
ctc att ccg ggt gag atg tgg tca gat aag gtg gag ctg cca gta act	403
Leu Ile Pro Gly Glu Met Trp Ser Asp Lys Val Glu Leu Pro Val Thr	
90 95 100	
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Ile Asp Lys Ala Ala Asp Glu Ala Glu Ile Ala Ile Ala Gln Gln	
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Gln Ser Gln Pro Gln Thr Arg Gly Leu Ala Ala Ala Ala Ala Cys Gln	
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acg ttt tgg ccg tca cct cat cag gtt tgt ggt gct att tta gag cgc	547
Thr Phe Trp Pro Ser Pro His Gln Val Cys Gly Ala Ile Leu Glu Arg	
135 140 145	
tat att cag cag ggt gcc cag ttt ggg tgg atg ttg ttt ccg agt gaa	595
Tyr Ile Gln Gln Gly Ala Gln Phe Gly Trp Met Leu Phe Pro Ser Glu	
150 155 160 165	
ggc caa acg tta aat cct gat ggt cag ggg tat cgt cag cgg ttt atg	643
Gly Gln Thr Leu Asn Pro Asp Gly Gln Gly Tyr Arg Gln Arg Phe Met	
170 175 180	
aat ggg ttt gtt tat tgg cat ccg aca act ggt gcg cat gct gtt aat	691
Asn Gly Phe Val Tyr Trp His Pro Thr Thr Gly Ala His Ala Val Asn	
185 190 195	
aat tac agt gcg cag gtg tgg gag cgt aat ggg tgg gag tct ggg tgg	739
Asn Tyr Ser Ala Gln Val Trp Glu Arg Asn Gly Trp Glu Ser Gly Trp	
200 205 210	
atg ggt tat ccc act ggt ggt gaa gtc cct gtg aat ggt tcc aat ccg	787
Met Gly Tyr Pro Thr Gly Gly Glu Val Pro Val Asn Gly Ser Asn Pro	
215 220 225	

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Ile Asp Gly Glu Leu Ser Gly Trp Val Gln Thr Phe Gln Gly Gly Arg	
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Val Tyr Arg Ser Pro Val Leu Asp Gly Phe Gln Val Ala Ser Ile Asn	
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Gly Leu Ile Leu Asp Lys Trp Leu Glu Leu Gly Gly Pro Asp Ser Asp	
265 270 275	
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Leu Gly Phe Pro Ile Ala Asp Glu Ala Val Thr Ala Asp Gly Val Gly	
280 285 290	
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Arg Phe Ser Val Phe Gln Asn Gly Val Val Tyr Trp His Pro Gln His	
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Gly Ala His Pro Ile Leu Gly Asn Ile Tyr Ser Ile Trp Arg Glu Glu	
310 315 320 325	
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Gly Ala Glu Ser Gly Glu Phe Gly Tyr Pro Ile Gly Asp Pro Glu Lys	
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Tyr Thr Glu Asn Met Ala Asn Gln Val Phe Glu Lys Gly Glu Leu Ala	
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Ala Asn Leu Tyr Pro Asn Pro Leu Glu Ala Phe Ile Glu Phe Leu Pro	
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Phe Ala Asn Leu Glu Glu Ala Ile Glu Tyr Phe Glu Asn Gly Leu Ser	
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Asn Ser Arg Val Glu Ala Asn Ser Leu Asn Ala Lys Lys Asp Ser Ile	
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Gln Cys Gln Ser Gln Ser Ala Asn Ile His Val Arg Thr Lys Ser Asp	
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Gly Val Gly Ile Arg Val Pro Lys Ile Gly Phe Lys Ala Arg Met Asp	
425 430 435	
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Cys Asp Leu Pro Gly Thr Val Ser Asp Val Val Gly Tyr Gly Trp Ile	
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 Cys Ser Gly Glu Lys Asn Thr Leu Phe Trp Gly Thr Ser Tyr Phe Gln  
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gag 1704

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 <212> PRT  
 <213> Corynebacterium glutamicum

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 35 40 45

Gly Asn Thr Pro Pro Val Val Asp Gly Val Gly Gly Tyr Thr Glu Gln  
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Glu Ile Ala Glu Ile His Glu Ala Ile Arg Gln Ala Gln Glu Ser Gly  
 65 70 75 80

Ala Pro Asn Glu Glu Leu Ile Pro Gly Glu Met Trp Ser Asp Lys Val  
 85 90 95

Glu Leu Pro Val Thr Ile Asp Lys Ala Ala Ala Asp Glu Ala Glu Ile  
 100 105 110

Ala Ile Ala Gln Gln Gln Ser Gln Pro Gln Thr Arg Gly Leu Ala Ala  
 115 120 125

Ala Ala Ala Cys Gln Thr Phe Trp Pro Ser Pro His Gln Val Cys Gly  
 130 135 140

Ala Ile Leu Glu Arg Tyr Ile Gln Gln Gly Ala Gln Phe Gly Trp Met

145	150	155	160
Leu Phe Pro Ser	Glu Gly Gln Thr Leu Asn Pro Asp Gly Gln Gly Tyr		
	165	170	175
Arg Gln Arg Phe Met Asn Gly Phe Val Tyr Trp His Pro Thr Thr Gly			
	180	185	190
Ala His Ala Val Asn Asn Tyr Ser Ala Gln Val Trp Glu Arg Asn Gly			
	195	200	205
Trp Glu Ser Gly Trp Met Gly Tyr Pro Thr Gly Gly Glu Val Pro Val			
	210	215	220
Asn Gly Ser Asn Pro Ile Asp Gly Glu Leu Ser Gly Trp Val Gln Thr			
	225	230	235
Phe Gln Gly Gly Arg Val Tyr Arg Ser Pro Val Leu Asp Gly Phe Gln			
	245	250	255
Val Ala Ser Ile Asn Gly Leu Ile Leu Asp Lys Trp Leu Glu Leu Gly			
	260	265	270
Gly Pro Asp Ser Asp Leu Gly Phe Pro Ile Ala Asp Glu Ala Val Thr			
	275	280	285
Ala Asp Gly Val Gly Arg Phe Ser Val Phe Gln Asn Gly Val Val Tyr			
	290	295	300
Trp His Pro Gln His Gly Ala His Pro Ile Leu Gly Asn Ile Tyr Ser			
	305	310	315
Ile Trp Arg Glu Glu Gly Ala Glu Ser Gly Glu Phe Gly Tyr Pro Ile			
	325	330	335
Gly Asp Pro Glu Lys Tyr Thr Glu Asn Met Ala Asn Gln Val Phe Glu			
	340	345	350
Lys Gly Glu Leu Ala Ala Asn Leu Tyr Pro Asn Pro Leu Glu Ala Phe			
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Ile Glu Phe Leu Pro Phe Ala Asn Leu Glu Glu Ala Ile Glu Tyr Phe			
	370	375	380
Glu Asn Gly Leu Ser Asn Ser Arg Val Glu Ala Asn Ser Leu Asn Ala			
	385	390	395
Lys Lys Asp Ser Ile Gln Cys Gln Ser Gln Ser Ala Asn Ile His Val			
	405	410	415
Arg Thr Lys Ser Asp Gly Val Gly Ile Arg Val Pro Lys Ile Gly Phe			
	420	425	430
Lys Ala Arg Met Asp Cys Asp Leu Pro Gly Thr Val Ser Asp Val Val			
	435	440	445
Gly Tyr Gly Trp Ile Tyr Tyr Asp Tyr Trp Gly Arg Trp Ala Gln Ala			

450

455

460

Ala Tyr Ala Gln Gln Phe Phe Gly Asn Arg Asn Ser Val Val Gln Thr  
 465 470 475 480

Asn Leu Glu Ala Gly Cys Ser Gly Glu Lys Asn Thr Leu Phe Trp Gly  
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Thr Ser Tyr Phe Gln Val Thr Tyr Glu Gly Gln Pro Tyr Phe Gly Gln  
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Ser Ala Thr Asn Tyr Ala Tyr Leu Pro Cys Thr Ile Asp Arg Ser  
 515 520 525

&lt;210&gt; 53

&lt;211&gt; 456

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(433)

&lt;223&gt; RXN02949

&lt;400&gt; 53

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 Val Ser Asp Glu Gln  
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aat tct ggc gta ggc gga acg tct cgc cca acg ggt aaa cgc cag ctg 163  
 Asn Ser Gly Val Gly Gly Thr Ser Arg Pro Thr Gly Lys Arg Gln Leu  
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 Ser Gly Ala Ser Thr Thr Ser Thr Ser Ser Tyr Glu Ala Lys Gln Val  
 25 30 35

tct aca cag aag aag tca tcc ggt tcg gat tct aag cct ggc ggc ggt 259  
 Ser Thr Gln Lys Lys Ser Ser Gly Ser Asp Ser Lys Pro Gly Gly Gly  
 40 45 50

gtt att tct ttt ctg cct gag gtt gtg gga gaa gtc cgt aag gtt att 307  
 Val Ile Ser Phe Leu Pro Glu Val Val Gly Glu Val Arg Lys Val Ile  
 55 60 65

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 Trp Pro Thr Ala Arg Gln Met Val Thr Tyr Thr Leu Val Val Leu Gly  
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 Phe Leu Ile Val Leu Thr Ala Leu Val Ser Gly Val Asp Phe Leu Ala  
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Gly Leu Gly Val Glu Lys Ile Leu Thr Pro  
 105 110

ttt

456

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 <213> Corynebacterium glutamicum

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 35 40 45  
 Lys Pro Gly Gly Gly Val Ile Ser Phe Leu Pro Glu Val Val Gly Glu  
 50 55 60  
 Val Arg Lys Val Ile Trp Pro Thr Ala Arg Gln Met Val Thr Tyr Thr  
 65 70 75 80  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1918)  
 <223> RXN02462

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 Met Thr Lys Asp Val  
 1 5  
 cac tac gaa gtc gac gaa cgt aaa aag acc gtc ggt gtg aaa gaa gaa 163  
 His Tyr Glu Val Asp Glu Arg Lys Lys Thr Val Gly Val Lys Glu Glu  
 10 15 20  
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 Gly Val Glu Tyr Val Glu Asp Gln Leu Gly Ile Asp Asn Leu Tyr Ala

25	30	35	
cct gag cac tca cag ctg gtc agc tac ctg aac aac gcc atc aag gca Pro Glu His Ser Gln Leu Val Ser Tyr Leu Asn Asn Ala Ile Lys Ala 40 45 50			259
cag gaa ctg ttc acc cgc gac aag gac tac atc gtc cgc aac ggc gaa Gln Glu Leu Phe Thr Arg Asp Lys Asp Tyr Ile Val Arg Asn Gly Glu 55 60 65			307
gtt atg atc gtc gac ggc ttc acc ggc cgt gtc ctt gcc ggc cgc cga Val Met Ile Val Asp Gly Phe Thr Gly Arg Val Leu Ala Gly Arg Arg 70 75 80 85			355
tac aac gaa ggc atg cac cag gcg atc gaa gcc aaa gag cgc gta gag Tyr Asn Glu Gly Met His Gln Ala Ile Glu Ala Lys Glu Arg Val Glu 90 95 100			403
atc aaa aac gag aac cag acc ctg gcg acc gtt acc ctc cag aac tac Ile Lys Asn Glu Asn Gln Thr Leu Ala Thr Val Thr Leu Gln Asn Tyr 105 110 115			451
ttc cgc ctc tac acc aaa ctc gcc ggc atg acc ggt acc gca gag acc Phe Arg Leu Tyr Thr Lys Leu Ala Gly Met Thr Gly Thr Ala Glu Thr 120 125 130			499
gaa gca gca gag ctc aac cag atc tac aag ctc gac gtc atc gcg atc Glu Ala Ala Glu Leu Asn Gln Ile Tyr Lys Leu Asp Val Ile Ala Ile 135 140 145			547
cca acc aac cga cca aac cag cgc gaa gac ttg acc gac ttg gtg tac Pro Thr Asn Arg Pro Asn Gln Arg Glu Asp Leu Thr Asp Leu Val Tyr 150 155 160 165			595
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cgc acc gaa aag ggc caa cca gtc ctc gtc ggt acc gtc tcc gtc gag Arg Thr Glu Lys Gly Gln Pro Val Leu Val Gly Thr Val Ser Val Glu 185 190 195			691
cgc tcc gaa tac ctc tcc cag ctg ttg acc aaa cga ggc atc aag cac Arg Ser Glu Tyr Leu Ser Gln Leu Leu Thr Lys Arg Gly Ile Lys His 200 205 210			739
aac gtc ctc aat gcg aag cac cac gag cag gaa gca cag atc gtt gct Asn Val Leu Asn Ala Lys His His Glu Gln Glu Ala Gln Ile Val Ala 215 220 225			787
cag gca ggt ctt cca ggc gcc gtc acc gtt gcc acc aac atg gcg ggc Gln Ala Gly Leu Pro Gly Ala Val Thr Val Ala Thr Asn Met Ala Gly 230 235 240 245			835
cgt gga acc gac atc gtg ctc ggc gga aac cca gaa atc ctc ctc gac Arg Gly Thr Asp Ile Val Leu Gly Gly Asn Pro Glu Ile Leu Leu Asp 250 255 260			883

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Ile Lys Leu Arg Glu Arg Gly Leu Asp Pro Phe Glu Asp Glu Glu Ser	
265 270 275	
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Tyr Gln Glu Ala Trp Asp Ala Glu Leu Pro Ala Met Lys Gln Arg Cys	
280 285 290	
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Glu Glu Arg Gly Asp Lys Val Arg Glu Ala Gly Gly Leu Tyr Val Leu	
295 300 305	
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Gly Thr Glu Arg His Glu Ser Arg Arg Ile Asp Asn Gln Leu Arg Gly	
310 315 320 325	
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Arg Ser Ala Arg Gln Gly Asp Pro Gly Ser Thr Arg Phe Tyr Leu Ser	
330 335 340	
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Met Met Asn Arg Leu Asn Val Pro Asp Asp Val Pro Ile Glu Ser Lys	
360 365 370	
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Thr Val Thr Asn Ser Ile Lys Gly Ala Gln Ala Gln Val Glu Asn Gln	
375 380 385	
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Asn Phe Glu Met Arg Lys Asn Val Leu Lys Tyr Asp Glu Val Met Asn	
390 395 400 405	
gaa cag cgc aag gtt atc tac agc gag cga cgc gaa atc ctc gaa tcc	1363
Glu Gln Arg Lys Val Ile Tyr Ser Glu Arg Arg Glu Ile Leu Glu Ser	
410 415 420	
gca gac atc tcc cgc tac atc caa aac atg atc gaa gaa aca gtc agc	1411
Ala Asp Ile Ser Arg Tyr Ile Gln Asn Met Ile Glu Glu Thr Val Ser	
425 430 435	
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Ala Tyr Val Asp Gly Ala Thr Ala Asn Gly Tyr Val Glu Asp Trp Asp	
440 445 450	
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Leu Asp Lys Leu Trp Asn Ala Leu Glu Ala Leu Tyr Asp Pro Ser Ile	
455 460 465	
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Asn Trp Thr Asp Leu Val Glu Gly Ser Glu Tyr Gly Lys Pro Gly Glu	
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gaa tac gca aaa ctc gaa gaa gcc gta tcc gca atc ggc ggc gaa gca 1651  
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cag atc cgc aac atc gaa cga atg gtg ctc atg cca gtc atc gac acc 1699  
 Gln Ile Arg Asn Ile Glu Arg Met Val Leu Met Pro Val Ile Asp Thr  
                     520                    525                    530

aaa tgg cgc gaa cac ctc tac gaa atg gac tac ctg aaa gaa ggc atc 1747  
 Lys Trp Arg Glu His Leu Tyr Glu Met Asp Tyr Leu Lys Glu Gly Ile  
                     535                    540                    545

ggc ctg cgc gca atg gca cag cgc gac cca ctg gtc gaa tac caa aag 1795  
 Gly Leu Arg Ala Met Ala Gln Arg Asp Pro Leu Val Glu Tyr Gln Lys  
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 Thr Val Arg Gln Leu Phe Leu Ser Ala Ser Ser Ser Ser Ser Lys Thr  
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atg 1941

&lt;210&gt; 56

&lt;211&gt; 606

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 56

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Asp Asn Leu Tyr Ala Pro Glu His Ser Gln Leu Val Ser Tyr Leu Asn  
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Asn Ala Ile Lys Ala Gln Glu Leu Phe Thr Arg Asp Lys Asp Tyr Ile  
                     50                    55                    60

Val Arg Asn Gly Glu Val Met Ile Val Asp Gly Phe Thr Gly Arg Val  
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Leu Ala Gly Arg Arg Tyr Asn Glu Gly Met His Gln Ala Ile Glu Ala

85										90					95				
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Thr	Leu	Gln	Asn	Tyr	Phe	Arg	Leu	Tyr	Thr	Lys	Leu	Ala	Gly	Met	Thr				
		115					120					125							
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Asp	Val	Ile	Ala	Ile	Pro	Thr	Asn	Arg	Pro	Asn	Gln	Arg	Glu	Asp	Leu				
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Thr	Val	Ser	Val	Glu	Arg	Ser	Glu	Tyr	Leu	Ser	Gln	Leu	Leu	Thr	Lys				
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Arg	Gly	Ile	Lys	His	Asn	Val	Leu	Asn	Ala	Lys	His	His	Glu	Gln	Glu				
	210					215					220								
Ala	Gln	Ile	Val	Ala	Gln	Ala	Gly	Leu	Pro	Gly	Ala	Val	Thr	Val	Ala				
225					230					235					240				
Thr	Asn	Met	Ala	Gly	Arg	Gly	Thr	Asp	Ile	Val	Leu	Gly	Gly	Asn	Pro				
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Glu	Ile	Leu	Leu	Asp	Ile	Lys	Leu	Arg	Glu	Arg	Gly	Leu	Asp	Pro	Phe				
		260						265					270						
Glu	Asp	Glu	Glu	Ser	Tyr	Gln	Glu	Ala	Trp	Asp	Ala	Glu	Leu	Pro	Ala				
	275						280					285							
Met	Lys	Gln	Arg	Cys	Glu	Glu	Arg	Gly	Asp	Lys	Val	Arg	Glu	Ala	Gly				
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Gly	Leu	Tyr	Val	Leu	Gly	Thr	Glu	Arg	His	Glu	Ser	Arg	Arg	Ile	Asp				
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Asn	Gln	Leu	Arg	Gly	Arg	Ser	Ala	Arg	Gln	Gly	Asp	Pro	Gly	Ser	Thr				
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Arg	Phe	Tyr	Leu	Ser	Met	Arg	Asp	Asp	Leu	Met	Val	Arg	Phe	Val	Gly				
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Pro	Thr	Met	Glu	Asn	Met	Met	Asn	Arg	Leu	Asn	Val	Pro	Asp	Asp	Val				
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Pro	Ile	Glu	Ser	Lys	Thr	Val	Thr	Asn	Ser	Ile	Lys	Gly	Ala	Gln	Ala				
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Gln	Val	Glu	Asn	Gln	Asn	Phe	Glu	Met	Arg	Lys	Asn	Val	Leu	Lys	Tyr				

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385              390              395              400
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Glu Ile Leu Glu Ser Ala Asp Ile Ser Arg Tyr Ile Gln Asn Met Ile
              420              425              430

Glu Glu Thr Val Ser Ala Tyr Val Asp Gly Ala Thr Ala Asn Gly Tyr
              435              440              445

Val Glu Asp Trp Asp Leu Asp Lys Leu Trp Asn Ala Leu Glu Ala Leu
              450              455              460

Tyr Asp Pro Ser Ile Asn Trp Thr Asp Leu Val Glu Gly Ser Glu Tyr
465              470              475              480

Gly Lys Pro Gly Glu Leu Ser Ala Glu Asp Leu Arg Thr Ala Leu Val
              485              490              495

Asn Asp Ala His Ala Glu Tyr Ala Lys Leu Glu Glu Ala Val Ser Ala
              500              505              510

Ile Gly Gly Glu Ala Gln Ile Arg Asn Ile Glu Arg Met Val Leu Met
              515              520              525

Pro Val Ile Asp Thr Lys Trp Arg Glu His Leu Tyr Glu Met Asp Tyr
              530              535              540

Leu Lys Glu Gly Ile Gly Leu Arg Ala Met Ala Gln Arg Asp Pro Leu
545              550              555              560

Val Glu Tyr Gln Lys Glu Gly Gly Asp Met Phe Asn Gly Met Lys Asp
              565              570              575

Gly Ile Lys Glu Glu Thr Val Arg Gln Leu Phe Leu Ser Ala Ser Ser
              580              585              590

Ser Ser Ser Lys Thr Arg Lys Ser Leu Thr Asn Ser Glu Pro
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<210> 57  
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 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1942)  
 <223> RXN01559

<400> 57  
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 cgcctgggaa cgatggccaa aacgcgcaat agcgttggtt gtg ctc atc gtc gtt 115  
 Val Leu Ile Val Val

1															5	
ggt	gtt	tat	gcg	ttg	gtg	ctg	ttg	aca	ggc	gat	cgt	tct	gcc	aca	cca	163
Gly	Val	Tyr	Ala	Leu	Val	Leu	Leu	Thr	Gly	Asp	Arg	Ser	Ala	Thr	Pro	
				10					15					20		
aaa	ttg	ggt	att	gat	ctg	caa	ggc	gga	acc	cga	gtg	acc	ctc	gtg	ccg	211
Lys	Leu	Gly	Ile	Asp	Leu	Gln	Gly	Gly	Thr	Arg	Val	Thr	Leu	Val	Pro	
			25				30						35			
cag	ggg	cag	gat	cca	act	cag	gac	cag	ctg	aat	cag	gca	cgc	acc	att	259
Gln	Gly	Gln	Asp	Pro	Thr	Gln	Asp	Gln	Leu	Asn	Gln	Ala	Arg	Thr	Ile	
		40					45					50				
ctg	gaa	aac	cgt	gtg	aac	ggc	atg	ggc	gtt	tca	ggt	gca	agc	gtg	gtc	307
Leu	Glu	Asn	Arg	Val	Asn	Gly	Met	Gly	Val	Ser	Gly	Ala	Ser	Val	Val	
	55					60					65					
gct	gac	ggt	aac	acg	ctg	gtg	atc	act	gtt	ccc	ggg	gaa	aat	acc	gca	355
Ala	Asp	Gly	Asn	Thr	Leu	Val	Ile	Thr	Val	Pro	Gly	Glu	Asn	Thr	Ala	
	70				75					80					85	
cag	gcg	caa	tcc	cta	gga	cag	acc	tcc	cag	ctg	ctg	ttc	cgt	ccc	gtt	403
Gln	Ala	Gln	Ser	Leu	Gly	Gln	Thr	Ser	Gln	Leu	Leu	Phe	Arg	Pro	Val	
				90					95					100		
ggt	cag	gca	gga	atg	ccc	gat	atg	acc	acg	ttg	atg	cca	gag	ctg	gaa	451
Gly	Gln	Ala	Gly	Met	Pro	Asp	Met	Thr	Thr	Leu	Met	Pro	Glu	Leu	Glu	
			105					110					115			
gag	atg	gcc	aac	agg	tgg	gtt	gaa	tac	ggc	gtc	atc	acc	gaa	gag	cag	499
Glu	Met	Ala	Asn	Arg	Trp	Val	Glu	Tyr	Gly	Val	Ile	Thr	Glu	Glu	Gln	
		120					125					130				
gca	aat	gcc	tcc	ttg	gag	gaa	atg	aac	acc	gct	gtt	gca	tcg	acc	act	547
Ala	Asn	Ala	Ser	Leu	Glu	Glu	Met	Asn	Thr	Ala	Val	Ala	Ser	Thr	Thr	
	135					140					145					
gcg	gtg	gaa	ggc	gaa	gaa	gca	act	gag	cca	gaa	ccc	gtc	acc	gtg	tcg	595
Ala	Val	Glu	Gly	Glu	Glu	Ala	Thr	Glu	Pro	Glu	Pro	Val	Thr	Val	Ser	
	150				155					160					165	
gcg	acc	cct	atg	gat	gag	cca	gcc	aac	tcc	att	gag	gca	aca	cag	cga	643
Ala	Thr	Pro	Met	Asp	Glu	Pro	Ala	Asn	Ser	Ile	Glu	Ala	Thr	Gln	Arg	
				170					175					180		
cgc	cag	gaa	atc	acg	gac	atg	ctg	cgc	acc	gac	cgc	cag	tcc	acc	gat	691
Arg	Gln	Glu	Ile	Thr	Asp	Met	Leu	Arg	Thr	Asp	Arg	Gln	Ser	Thr	Asp	
			185					190					195			
ccc	act	gtc	cag	atc	gct	gca	agt	tct	ttg	atg	cag	tgc	acc	act	gat	739
Pro	Thr	Val	Gln	Ile	Ala	Ala	Ser	Ser	Leu	Met	Gln	Cys	Thr	Thr	Asp	
		200					205					210				
gag	atg	gat	cct	ttg	gcc	ggc	acc	gat	gat	cca	cgc	ctg	cca	ttg	gtg	787
Glu	Met	Asp	Pro	Leu	Ala	Gly	Thr	Asp	Asp	Pro	Arg	Leu	Pro	Leu	Val	
	215					220					225					

gca tgt gat cca gct gta ggt ggc gtg tat gta ctt gat cct gca cct	835
Ala Cys Asp Pro Ala Val Gly Gly Val Tyr Val Leu Asp Pro Ala Pro	
230 235 240 245	
ttg ctc aac ggc gaa acc gat gag gaa aat ggt gcg cgc cta acc ggt	883
Leu Leu Asn Gly Glu Thr Asp Glu Glu Asn Gly Ala Arg Leu Thr Gly	
250 255 260	
aat gag atc gat acc aac cgt ccc atc acc ggt gga ttc aac gcc cag	931
Asn Glu Ile Asp Thr Asn Arg Pro Ile Thr Gly Gly Phe Asn Ala Gln	
265 270 275	
tcc ggc cag atg gaa atc agc ttt gcc ttc aaa tcc ggc gat ggg gaa	979
Ser Gly Gln Met Glu Ile Ser Phe Ala Phe Lys Ser Gly Asp Gly Glu	
280 285 290	
gaa ggc tct gca act tgg tcc tct ctg acc agc cag tac ctg cag cag	1027
Glu Gly Ser Ala Thr Trp Ser Ser Leu Thr Ser Gln Tyr Leu Gln Gln	
295 300 305	
cag atc gcc atc acc ctg gac tct cag gtg att tct gca ccc gtg att	1075
Gln Ile Ala Ile Thr Leu Asp Ser Gln Val Ile Ser Ala Pro Val Ile	
310 315 320 325	
cag tca gca acc cct gtg ggt tct gca aca tcc atc acc ggt gac ttc	1123
Gln Ser Ala Thr Pro Val Gly Ser Ala Thr Ser Ile Thr Gly Asp Phe	
330 335 340	
act caa act gaa gcc caa gat ctg gcg aac aac ctg cgc tac ggt gca	1171
Thr Gln Thr Glu Ala Gln Asp Leu Ala Asn Asn Leu Arg Tyr Gly Ala	
345 350 355	
ttg ccc ctg agc ttc gca ggt gaa aac ggc gag cgc ggc gga act acc	1219
Leu Pro Leu Ser Phe Ala Gly Glu Asn Gly Glu Arg Gly Gly Thr Thr	
360 365 370	
acc acc gtt ccg cca tca cta ggc gca gca tcc ttg aag gcc gga ctg	1267
Thr Thr Val Pro Pro Ser Leu Gly Ala Ala Ser Leu Lys Ala Gly Leu	
375 380 385	
atc gca ggc atc gtc ggc atc gcg ctg gtc gcc atc ttc gtg ttc gcc	1315
Ile Ala Gly Ile Val Gly Ile Ala Leu Val Ala Ile Phe Val Phe Ala	
390 395 400 405	
tac tac cgc gtc ttc gga ttc gtt tcc ctg ttc acc ctg ttt gcc gca	1363
Tyr Tyr Arg Val Phe Gly Phe Val Ser Leu Phe Thr Leu Phe Ala Ala	
410 415 420	
ggc gtg ttg gtc tac ggc ctt ctg gta ctg ctg gga cgc tgg atc gga	1411
Gly Val Leu Val Tyr Gly Leu Leu Val Leu Leu Gly Arg Trp Ile Gly	
425 430 435	
tat tcc cta gac ctt gct ggt atc gcc ggt ttg atc atc ggt atc ggt	1459
Tyr Ser Leu Asp Leu Ala Gly Ile Ala Gly Leu Ile Ile Gly Ile Gly	
440 445 450	

acc acc gcc gac tcc ttc gtg gtg ttc tat gag cgc atc aag gat gag 1507  
 Thr Thr Ala Asp Ser Phe Val Val Phe Tyr Glu Arg Ile Lys Asp Glu  
 455 460 465

atc cgt gaa gga aga tcc ttt aga tct gca gta cct cgt gca tgg gaa 1555  
 Ile Arg Glu Gly Arg Ser Phe Arg Ser Ala Val Pro Arg Ala Trp Glu  
 470 475 480 485

agc gcc aag cgc acc atc gtc aca ggc aac atg gtc act ttg ctc ggc 1603  
 Ser Ala Lys Arg Thr Ile Val Thr Gly Asn Met Val Thr Leu Leu Gly  
 490 495 500

gct atc gtg att tac ttg ctc gcg gtc ggc gaa gtc aag ggc ttt gcc 1651  
 Ala Ile Val Ile Tyr Leu Leu Ala Val Gly Glu Val Lys Gly Phe Ala  
 505 510 515

ttc acc ctg ggt ctg acc acc gta ttc gat ctc gtt gtc acc ttc ctg 1699  
 Phe Thr Leu Gly Leu Thr Thr Val Phe Asp Leu Val Val Thr Phe Leu  
 520 525 530

atc acg gca cca ctg gtt atc ctg gca tca cgc aac cca ttc ttt gcc 1747  
 Ile Thr Ala Pro Leu Val Ile Leu Ala Ser Arg Asn Pro Phe Phe Ala  
 535 540 545

aag tca tcg gtc aac ggc atg gga cga gtg atg aag ctc gtt gaa gaa 1795  
 Lys Ser Ser Val Asn Gly Met Gly Arg Val Met Lys Leu Val Glu Glu  
 550 555 560 565

cgc cgc gcc aac ggt gaa ttg gat gag cct gag tac ctg aaa aag atc 1843  
 Arg Arg Ala Asn Gly Glu Leu Asp Glu Pro Glu Tyr Leu Lys Lys Ile  
 570 575 580

cat gcc aag aat gcg gca gct gat aag gct tcc act gac aat tct tcc 1891  
 His Ala Lys Asn Ala Ala Ala Asp Lys Ala Ser Thr Asp Asn Ser Ser  
 585 590 595

act gac aat tct gaa gca cct ggc acc gat acg aac caa gag gag gag 1939  
 Thr Asp Asn Ser Glu Ala Pro Gly Thr Asp Thr Asn Gln Glu Glu Glu  
 600 605 610

aag tagccatgac tgattcccag act 1965  
 Lys

&lt;210&gt; 58

&lt;211&gt; 614

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 58

Val Leu Ile Val Val Gly Val Tyr Ala Leu Val Leu Leu Thr Gly Asp  
 1 5 10 15

Arg Ser Ala Thr Pro Lys Leu Gly Ile Asp Leu Gln Gly Gly Thr Arg  
 20 25 30



Val Thr Leu Val Pro Gln Gly Gln Asp Pro Thr Gln Asp Gln Leu Asn  
 35 40 45  
 Gln Ala Arg Thr Ile Leu Glu Asn Arg Val Asn Gly Met Gly Val Ser  
 50 55 60  
 Gly Ala Ser Val Val Ala Asp Gly Asn Thr Leu Val Ile Thr Val Pro  
 65 70 75 80  
 Gly Glu Asn Thr Ala Gln Ala Gln Ser Leu Gly Gln Thr Ser Gln Leu  
 85 90 95  
 Leu Phe Arg Pro Val Gly Gln Ala Gly Met Pro Asp Met Thr Thr Leu  
 100 105 110  
 Met Pro Glu Leu Glu Glu Met Ala Asn Arg Trp Val Glu Tyr Gly Val  
 115 120 125  
 Ile Thr Glu Glu Gln Ala Asn Ala Ser Leu Glu Glu Met Asn Thr Ala  
 130 135 140  
 Val Ala Ser Thr Thr Ala Val Glu Gly Glu Glu Ala Thr Glu Pro Glu  
 145 150 155 160  
 Pro Val Thr Val Ser Ala Thr Pro Met Asp Glu Pro Ala Asn Ser Ile  
 165 170 175  
 Glu Ala Thr Gln Arg Arg Gln Glu Ile Thr Asp Met Leu Arg Thr Asp  
 180 185 190  
 Arg Gln Ser Thr Asp Pro Thr Val Gln Ile Ala Ala Ser Ser Leu Met  
 195 200 205  
 Gln Cys Thr Thr Asp Glu Met Asp Pro Leu Ala Gly Thr Asp Asp Pro  
 210 215 220  
 Arg Leu Pro Leu Val Ala Cys Asp Pro Ala Val Gly Gly Val Tyr Val  
 225 230 235 240  
 Leu Asp Pro Ala Pro Leu Leu Asn Gly Glu Thr Asp Glu Glu Asn Gly  
 245 250 255  
 Ala Arg Leu Thr Gly Asn Glu Ile Asp Thr Asn Arg Pro Ile Thr Gly  
 260 265 270  
 Gly Phe Asn Ala Gln Ser Gly Gln Met Glu Ile Ser Phe Ala Phe Lys  
 275 280 285  
 Ser Gly Asp Gly Glu Glu Gly Ser Ala Thr Trp Ser Ser Leu Thr Ser  
 290 295 300  
 Gln Tyr Leu Gln Gln Gln Ile Ala Ile Thr Leu Asp Ser Gln Val Ile  
 305 310 315 320  
 Ser Ala Pro Val Ile Gln Ser Ala Thr Pro Val Gly Ser Ala Thr Ser  
 325 330 335

Ile Thr Gly Asp Phe Thr Gln Thr Glu Ala Gln Asp Leu Ala Asn Asn  
 340 345 350  
 Leu Arg Tyr Gly Ala Leu Pro Leu Ser Phe Ala Gly Glu Asn Gly Glu  
 355 360 365  
 Arg Gly Gly Thr Thr Thr Thr Val Pro Pro Ser Leu Gly Ala Ala Ser  
 370 375 380  
 Leu Lys Ala Gly Leu Ile Ala Gly Ile Val Gly Ile Ala Leu Val Ala  
 385 390 395 400  
 Ile Phe Val Phe Ala Tyr Tyr Arg Val Phe Gly Phe Val Ser Leu Phe  
 405 410 415  
 Thr Leu Phe Ala Ala Gly Val Leu Val Tyr Gly Leu Leu Val Leu Leu  
 420 425 430  
 Gly Arg Trp Ile Gly Tyr Ser Leu Asp Leu Ala Gly Ile Ala Gly Leu  
 435 440 445  
 Ile Ile Gly Ile Gly Thr Thr Ala Asp Ser Phe Val Val Phe Tyr Glu  
 450 455 460  
 Arg Ile Lys Asp Glu Ile Arg Glu Gly Arg Ser Phe Arg Ser Ala Val  
 465 470 475 480  
 Pro Arg Ala Trp Glu Ser Ala Lys Arg Thr Ile Val Thr Gly Asn Met  
 485 490 495  
 Val Thr Leu Leu Gly Ala Ile Val Ile Tyr Leu Leu Ala Val Gly Glu  
 500 505 510  
 Val Lys Gly Phe Ala Phe Thr Leu Gly Leu Thr Thr Val Phe Asp Leu  
 515 520 525  
 Val Val Thr Phe Leu Ile Thr Ala Pro Leu Val Ile Leu Ala Ser Arg  
 530 535 540  
 Asn Pro Phe Phe Ala Lys Ser Ser Val Asn Gly Met Gly Arg Val Met  
 545 550 555 560  
 Lys Leu Val Glu Glu Arg Arg Ala Asn Gly Glu Leu Asp Glu Pro Glu  
 565 570 575  
 Tyr Leu Lys Lys Ile His Ala Lys Asn Ala Ala Ala Asp Lys Ala Ser  
 580 585 590  
 Thr Asp Asn Ser Ser Thr Asp Asn Ser Glu Ala Pro Gly Thr Asp Thr  
 595 600 605  
 Asn Gln Glu Glu Glu Lys  
 610

&lt;210&gt; 59

&lt;211&gt; 819

<212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(796)  
 <223> RXN00046

<400> 59

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acctaaaacg ctgtttctcaa cacaggagtt tccttaaata atg gac tta aat act 115
                                   Met Asp Leu Asn Thr
                                   1                               5

caa cgc tca aag ctc tac gca cag ctt caa ggc cag ctc att gtt tcc 163
Gln Arg Ser Lys Leu Tyr Ala Gln Leu Gln Gly Gln Leu Ile Val Ser
              10              15              20

gtg caa gct ccc gac ggc cat gcc atg cga gat acc cat acg ctc acc 211
Val Gln Ala Pro Asp Gly His Ala Met Arg Asp Thr His Thr Leu Thr
              25              30              35

cat gtg gcc gca gcc tgt gtc gat ggc ggt gct cct gcc att cgc tgt 259
His Val Ala Ala Ala Cys Val Asp Gly Gly Ala Pro Ala Ile Arg Cys
              40              45              50

ggc ggt tac ggc ggt ttg gaa gat atc cgt tca atc tcc aac cgt gtc 307
Gly Gly Tyr Gly Gly Leu Glu Asp Ile Arg Ser Ile Ser Asn Arg Val
              55              60              65

gac gtt ccc gtt ttc gga ctc acc aaa gaa ggc tcc gaa gga gtt tac 355
Asp Val Pro Val Phe Gly Leu Thr Lys Glu Gly Ser Glu Gly Val Tyr
              70              75              80              85

atc acc cca acc agg gat tcc gtt cga gca gtg gca gaa tcc ggc gcc 403
Ile Thr Pro Thr Arg Asp Ser Val Arg Ala Val Ala Glu Ser Gly Ala
              90              95              100

act gta gtc tgc gcg gat gca act ttc cga cct agg cct gac ggc tcc 451
Thr Val Val Cys Ala Asp Ala Thr Phe Arg Pro Arg Pro Asp Gly Ser
              105              110              115

acc ttt gca gag ctg gtc act gtt gcc cac gat tcc gga att ctc atc 499
Thr Phe Ala Glu Leu Val Thr Val Ala His Asp Ser Gly Ile Leu Ile
              120              125              130

atg gcg gac tgc gca act ccc gaa gaa gtt ctc agt gcg cat aag gct 547
Met Ala Asp Cys Ala Thr Pro Glu Glu Val Leu Ser Ala His Lys Ala
              135              140              145

ggc gcg gat ttt gtg tcc acc acg ctt gct gga tac acc gaa cac cgc 595
Gly Ala Asp Phe Val Ser Thr Thr Leu Ala Gly Tyr Thr Glu His Arg
150              155              160              165

gag aaa aca gtc ggt cca gat ttc gat tgc ctc cgc gaa gca cgt gag 643
Glu Lys Thr Val Gly Pro Asp Phe Asp Cys Leu Arg Glu Ala Arg Glu

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170	175	180	
tta gtt ccc gat gcg ttc ctc att ggc gaa ggt cgc ttc tcc aac cct			691
Leu Val Pro Asp Ala Phe Leu Ile Gly Glu Gly Arg Phe Ser Asn Pro			
185	190	195	
gcg gat gtg gcg cac ggt cgt ctc att ggt gcc aac gcg atc atc gtg			739
Ala Asp Val Ala His Gly Arg Leu Ile Gly Ala Asn Ala Ile Ile Val			
200	205	210	
ggc acc gca atc act gac cct ggt ttc atc act gga cag ttc gcg tca			787
Gly Thr Ala Ile Thr Asp Pro Gly Phe Ile Thr Gly Gln Phe Ala Ser			
215	220	225	
ctg ttg cac tagcacttag tccagcgctg cac			819
Leu Leu His			
230			
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<211> 232			
<212> PRT			
<213> Corynebacterium glutamicum			
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Gln Leu Ile Val Ser Val Gln Ala Pro Asp Gly His Ala Met Arg Asp			
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Thr His Thr Leu Thr His Val Ala Ala Ala Cys Val Asp Gly Gly Ala			
35	40	45	
Pro Ala Ile Arg Cys Gly Gly Tyr Gly Gly Leu Glu Asp Ile Arg Ser			
50	55	60	
Ile Ser Asn Arg Val Asp Val Pro Val Phe Gly Leu Thr Lys Glu Gly			
65	70	75	80
Ser Glu Gly Val Tyr Ile Thr Pro Thr Arg Asp Ser Val Arg Ala Val			
85	90	95	
Ala Glu Ser Gly Ala Thr Val Val Cys Ala Asp Ala Thr Phe Arg Pro			
100	105	110	
Arg Pro Asp Gly Ser Thr Phe Ala Glu Leu Val Thr Val Ala His Asp			
115	120	125	
Ser Gly Ile Leu Ile Met Ala Asp Cys Ala Thr Pro Glu Glu Val Leu			
130	135	140	
Ser Ala His Lys Ala Gly Ala Asp Phe Val Ser Thr Thr Leu Ala Gly			
145	150	155	160
Tyr Thr Glu His Arg Glu Lys Thr Val Gly Pro Asp Phe Asp Cys Leu			
165	170	175	

Arg Glu Ala Arg Glu Leu Val Pro Asp Ala Phe Leu Ile Gly Glu Gly  
 180 185 190

Arg Phe Ser Asn Pro Ala Asp Val Ala His Gly Arg Leu Ile Gly Ala  
 195 200 205

Asn Ala Ile Ile Val Gly Thr Ala Ile Thr Asp Pro Gly Phe Ile Thr  
 210 215 220

Gly Gln Phe Ala Ser Leu Leu His  
 225 230

<210> 61  
 <211> 1219  
 <212> DNA  
 <213> Corynebacterium glutamicum

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 <222> (48)..(1196)  
 <223> RXN01863

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 Met Asn Ser  
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 Val Lys Leu Lys Gln Pro Val Ser Ile Tyr Asn Asp Pro Trp Glu Ser  
 5 10 15

tat aac gat gtt aaa gaa cat ggc caa tta act tta agt aac atc gaa 152  
 Tyr Asn Asp Val Lys Glu His Gly Gln Leu Thr Leu Ser Asn Ile Glu  
 20 25 30 35

ttt aca act aca aat ctt tgt aat atg cgt tgt agc cac tgt gca gtt 200  
 Phe Thr Thr Thr Asn Leu Cys Asn Met Arg Cys Ser His Cys Ala Val  
 40 45 50

ggt tat act tta caa act gtc gac ccc gag cct tta gat atg gac tta 248  
 Gly Tyr Thr Leu Gln Thr Val Asp Pro Glu Pro Leu Asp Met Asp Leu  
 55 60 65

att tat cgt aga ctt gat gaa att cca aat ctg cga acg atg tca att 296  
 Ile Tyr Arg Arg Leu Asp Glu Ile Pro Asn Leu Arg Thr Met Ser Ile  
 70 75 80

aca ggt ggc gaa cca atg ttt tct aaa aag tct att aga aat gtt gtt 344  
 Thr Gly Gly Glu Pro Met Phe Ser Lys Lys Ser Ile Arg Asn Val Val  
 85 90 95

aaa cct cta tta aag tat gca cat cat cga ggt ata tat aca caa atg 392  
 Lys Pro Leu Leu Lys Tyr Ala His His Arg Gly Ile Tyr Thr Gln Met  
 100 105 110 115

aat tca aac cta aca ttg cct caa gat cgt tat tta gat att gct gaa	440
Asn Ser Asn Leu Thr Leu Pro Gln Asp Arg Tyr Leu Asp Ile Ala Glu	
120 125 130	
tat atc gat gtt atg cat atc tca cat aac tgg gga aca act gat gaa	488
Tyr Ile Asp Val Met His Ile Ser His Asn Trp Gly Thr Thr Asp Glu	
135 140 145	
ttc gca aat gtt ggc ttt ggc gca atg aag aag caa cca ccg tta aaa	536
Phe Ala Asn Val Gly Phe Gly Ala Met Lys Lys Gln Pro Pro Leu Lys	
150 155 160	
gct aag tta aaa tta tat gaa caa atg att tcg aat gca cgt aca tta	584
Ala Lys Leu Lys Leu Tyr Glu Gln Met Ile Ser Asn Ala Arg Thr Leu	
165 170 175	
tca gaa caa gga atg ttt gta tct gcg gaa aca atg ctc aat caa agt	632
Ser Glu Gln Gly Met Phe Val Ser Ala Glu Thr Met Leu Asn Gln Ser	
180 185 190 195	
acg cta cca cat tta cga aaa ata cat caa gaa gtc gtt cat gat atg	680
Thr Leu Pro His Leu Arg Lys Ile His Gln Glu Val Val His Asp Met	
200 205 210	
aaa tgt agc aga cac gag att cac cct atg tat cca gct gac ttt gca	728
Lys Cys Ser Arg His Glu Ile His Pro Met Tyr Pro Ala Asp Phe Ala	
215 220 225	
agt caa tta aat gtg tta act cta gcg gaa atg aaa aag aca att cat	776
Ser Gln Leu Asn Val Leu Thr Leu Ala Glu Met Lys Lys Thr Ile His	
230 235 240	
gat ata ttg gat ttc aga gat gaa gat att tgg atg tta ttt ggt act	824
Asp Ile Leu Asp Phe Arg Asp Glu Asp Ile Trp Met Leu Phe Gly Thr	
245 250 255	
ttg cct gtg ttt cca tgc tta aag gat gat gaa gat caa aag tta cta	872
Leu Pro Val Phe Pro Cys Leu Lys Asp Asp Glu Asp Gln Lys Leu Leu	
260 265 270 275	
tca cgt tta aga aat gct aac aat gta acg act aga aat gac ccg gat	920
Ser Arg Leu Arg Asn Ala Asn Asn Val Thr Thr Arg Asn Asp Pro Asp	
280 285 290	
ggc cgt agt cgt tta aat gtc aat gta ttt aca ggt aat gta atc gta	968
Gly Arg Ser Arg Leu Asn Val Asn Val Phe Thr Gly Asn Val Ile Val	
295 300 305	
act gat ttc gga gat gaa aca ggt aca att tcg aat ata caa aaa gat	1016
Thr Asp Phe Gly Asp Glu Thr Gly Thr Ile Ser Asn Ile Gln Lys Asp	
310 315 320	
aaa tta aca gat gta ttt gat aaa tgg tta tcc tct gat ctt gct aaa	1064
Lys Leu Thr Asp Val Phe Asp Lys Trp Leu Ser Ser Asp Leu Ala Lys	
325 330 335	
tca tta aat tgt cat tgt tcc gag ttt agt tgt tta gga cca aat gtt	1112



Ser Leu Asn Cys His Cys Ser Glu Phe Ser Cys Leu Gly Pro Asn Val  
340 345 350 355

ctt gtt aaa aat atg tac tat ccg aat atg gat ttt aaa gat aat gag 1160  
Leu Val Lys Asn Met Tyr Tyr Pro Asn Met Asp Phe Lys Asp Asn Glu  
360 365 370

cgt cat atg cac aaa caa cca caa att ata caa ttt taaaaactct 1206  
Arg His Met His Lys Gln Pro Gln Ile Ile Gln Phe  
375 380

taattatgcg gag 1219

<210> 62

<211> 383

<212> PRT

<213> Corynebacterium glutamicum

<400> 62

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Asn Ile Glu Phe Thr Thr Thr Asn Leu Cys Asn Met Arg Cys Ser His  
35 40 45

Cys Ala Val Gly Tyr Thr Leu Gln Thr Val Asp Pro Glu Pro Leu Asp  
50 55 60

Met Asp Leu Ile Tyr Arg Arg Leu Asp Glu Ile Pro Asn Leu Arg Thr  
65 70 75 80

Met Ser Ile Thr Gly Gly Glu Pro Met Phe Ser Lys Lys Ser Ile Arg  
85 90 95

Asn Val Val Lys Pro Leu Leu Lys Tyr Ala His His Arg Gly Ile Tyr  
100 105 110

Thr Gln Met Asn Ser Asn Leu Thr Leu Pro Gln Asp Arg Tyr Leu Asp  
115 120 125

Ile Ala Glu Tyr Ile Asp Val Met His Ile Ser His Asn Trp Gly Thr  
130 135 140

Thr Asp Glu Phe Ala Asn Val Gly Phe Gly Ala Met Lys Lys Gln Pro  
145 150 155 160

Pro Leu Lys Ala Lys Leu Lys Leu Tyr Glu Gln Met Ile Ser Asn Ala  
165 170 175

Arg Thr Leu Ser Glu Gln Gly Met Phe Val Ser Ala Glu Thr Met Leu  
180 185 190

Asn Gln Ser Thr Leu Pro His Leu Arg Lys Ile His Gln Glu Val Val

195							200				205				
His	Asp	Met	Lys	Cys	Ser	Arg	His	Glu	Ile	His	Pro	Met	Tyr	Pro	Ala
210						215				220					
Asp	Phe	Ala	Ser	Gln	Leu	Asn	Val	Leu	Thr	Leu	Ala	Glu	Met	Lys	Lys
225					230					235					240
Thr	Ile	His	Asp	Ile	Leu	Asp	Phe	Arg	Asp	Glu	Asp	Ile	Trp	Met	Leu
				245					250				255		
Phe	Gly	Thr	Leu	Pro	Val	Phe	Pro	Cys	Leu	Lys	Asp	Asp	Glu	Asp	Gln
			260					265					270		
Lys	Leu	Leu	Ser	Arg	Leu	Arg	Asn	Ala	Asn	Asn	Val	Thr	Thr	Arg	Asn
	275						280					285			
Asp	Pro	Asp	Gly	Arg	Ser	Arg	Leu	Asn	Val	Asn	Val	Phe	Thr	Gly	Asn
	290					295				300					
Val	Ile	Val	Thr	Asp	Phe	Gly	Asp	Glu	Thr	Gly	Thr	Ile	Ser	Asn	Ile
305					310					315					320
Gln	Lys	Asp	Lys	Leu	Thr	Asp	Val	Phe	Asp	Lys	Trp	Leu	Ser	Ser	Asp
				325					330					335	
Leu	Ala	Lys	Ser	Leu	Asn	Cys	His	Cys	Ser	Glu	Phe	Ser	Cys	Leu	Gly
			340					345					350		
Pro	Asn	Val	Leu	Val	Lys	Asn	Met	Tyr	Tyr	Pro	Asn	Met	Asp	Phe	Lys
		355				360						365			
Asp	Asn	Glu	Arg	His	Met	His	Lys	Gln	Pro	Gln	Ile	Ile	Gln	Phe	
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(595)  
 <223> RXN00833

<400> 63  
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 tttctagcac caaaacaaaa ctctccctag tatgggggtcc atg gct aaa aca cat 115  
 Met Ala Lys Thr His  
 1 5  
 ttt caa ggc aac gaa act gct acc tcc ggc gaa ctg cca cag gtc ggc 163  
 Phe Gln Gly Asn Glu Thr Ala Thr Ser Gly Glu Leu Pro Gln Val Gly  
 10 15 20

gac aac ctc gca gag ttc aac ctc gtc aac acc gaa ctg ggc gag gtc 211  
 Asp Asn Leu Ala Glu Phe Asn Leu Val Asn Thr Glu Leu Gly Glu Val  
                   25                                  30                                  35

tcc tca aag gac ttc cag ggc cgc aag ctt gtc ctg aac atc ttc cca 259  
 Ser Ser Lys Asp Phe Gln Gly Arg Lys Leu Val Leu Asn Ile Phe Pro  
                   40                                  45                                  50

tcc gtt gac acc ggc gtt tgt gca aca tca gtc cgc aag ttc aac gag 307  
 Ser Val Asp Thr Gly Val Cys Ala Thr Ser Val Arg Lys Phe Asn Glu  
                   55                                  60                                  65

gca gca gca agc ctg gaa aac acc acc gtg ctg tgc atc tcc aag gat 355  
 Ala Ala Ala Ser Leu Glu Asn Thr Thr Val Leu Cys Ile Ser Lys Asp  
                   70                                  75                                  80                                  85

ctt cca ttc gca ctg ggc cgt ttc tgc tcc gca gaa ggc atc gag aac 403  
 Leu Pro Phe Ala Leu Gly Arg Phe Cys Ser Ala Glu Gly Ile Glu Asn  
                                   90                                  95                                  100

gtc acc cca gta tcc gca ttc cgt tcc acc ttc ggt gaa gac aac ggc 451  
 Val Thr Pro Val Ser Ala Phe Arg Ser Thr Phe Gly Glu Asp Asn Gly  
                                   105                                  110                                  115

atc gtg ctc gaa ggc tca cca ctt aag ggt ctt ctt gca cgc agc gtc 499  
 Ile Val Leu Glu Gly Ser Pro Leu Lys Gly Leu Leu Ala Arg Ser Val  
                   120                                  125                                  130

atc gtc gtc gat gaa aac ggc aag gtt gct tac acc cag ttg gtt gat 547  
 Ile Val Val Asp Glu Asn Gly Lys Val Ala Tyr Thr Gln Leu Val Asp  
                   135                                  140                                  145

gag atc ttc act gaa cct gat tac gac gct gca ctt gct ggg ctg aac 595  
 Glu Ile Phe Thr Glu Pro Asp Tyr Asp Ala Ala Leu Ala Gly Leu Asn  
                   150                                  155                                  160                                  165

taatttactt cgctcagggg aat 618

<210> 64  
 <211> 165  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 64  
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           1                                  5                                  10                                  15

Leu Pro Gln Val Gly Asp Asn Leu Ala Glu Phe Asn Leu Val Asn Thr  
                   20                                  25                                  30

Glu Leu Gly Glu Val Ser Ser Lys Asp Phe Gln Gly Arg Lys Leu Val  
                   35                                  40                                  45

Leu Asn Ile Phe Pro Ser Val Asp Thr Gly Val Cys Ala Thr Ser Val  
                   50                                  55                                  60

Arg Lys Phe Asn Glu Ala Ala Ala Ser Leu Glu Asn Thr Thr Val Leu  
 65 70 75 80  
 Cys Ile Ser Lys Asp Leu Pro Phe Ala Leu Gly Arg Phe Cys Ser Ala  
 85 90 95  
 Glu Gly Ile Glu Asn Val Thr Pro Val Ser Ala Phe Arg Ser Thr Phe  
 100 105 110  
 Gly Glu Asp Asn Gly Ile Val Leu Glu Gly Ser Pro Leu Lys Gly Leu  
 115 120 125  
 Leu Ala Arg Ser Val Ile Val Val Asp Glu Asn Gly Lys Val Ala Tyr  
 130 135 140  
 Thr Gln Leu Val Asp Glu Ile Phe Thr Glu Pro Asp Tyr Asp Ala Ala  
 145 150 155 160  
 Leu Ala Gly Leu Asn  
 165

<210> 65  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 accagcattt tttgcatcct cagtgggtgc tggcccgcg atg atc ctt cac ggt 115  
 Met Ile Leu His Gly  
 1 5  
 gtt gtg ttc tac gca gga ctt cta gta ctt ctc gtg cca ctt ggc ctt 163  
 Val Val Phe Tyr Ala Gly Leu Leu Val Leu Leu Val Pro Leu Gly Leu  
 10 15 20  
 ggt gcg gga atc ctc ggc gag ctg ttt atc acc caa cgc cag acc atc 211  
 Gly Ala Gly Ile Leu Gly Glu Leu Phe Ile Thr Gln Arg Gln Thr Ile  
 25 30 35  
 atc gtg gtt tca tcg atc gtg ctg att atc cta ggt ttt gtc cag atc 259  
 Ile Val Val Ser Ser Ile Val Leu Ile Ile Leu Gly Phe Val Gln Ile  
 40 45 50  
 ttc ggc ggc gga ttc gac ttc gga aaa gca ctc cca gga tta gat cgt 307  
 Phe Gly Gly Gly Phe Asp Phe Gly Lys Ala Leu Pro Gly Leu Asp Arg  
 55 60 65  
 ctg caa tct aag gcc act gtg acc tca ggt cta gga aag agc ttt tta 355  
 Leu Gln Ser Lys Ala Thr Val Thr Ser Gly Leu Gly Lys Ser Phe Leu

70	75	80	85	
cta gga atg acc agt agt att gcc ggt ttt tgt tcc gga cca atc ctc				403
Leu Gly Met Thr Ser Ser Ile Ala Gly Phe Cys Ser Gly Pro Ile Leu				
	90	95	100	
ggc gcc gtt ctt act ttg gct gcc acc agt gga aac tcc atc acc tca				451
Gly Ala Val Leu Thr Leu Ala Ala Thr Ser Gly Asn Ser Ile Thr Ser				
	105	110	115	
gca ctc att ttg agt gct tat ggt gcg gga atg gtg ctg ccc ctg atg				499
Ala Leu Ile Leu Ser Ala Tyr Gly Ala Gly Met Val Leu Pro Leu Met				
	120	125	130	
gct att gca gcg ctc tgg gcc aaa ctc gga cag cgt gga cag cag atg				547
Ala Ile Ala Ala Leu Trp Ala Lys Leu Gly Gln Arg Gly Gln Gln Met				
	135	140	145	
ctc cgc ggc cgg gaa ttc acc ttc ttg ggc agg cag tgg cac att gtt				595
Leu Arg Gly Arg Glu Phe Thr Phe Leu Gly Arg Gln Trp His Ile Val				
	150	155	160	165
tct gtc att agc ggt gcc ctg atc atc gct gtc gga atc ctc ttt tgg				643
Ser Val Ile Ser Gly Ala Leu Ile Ile Ala Val Gly Ile Leu Phe Trp				
	170	175	180	
tcc acg aac ggc ctt gtc agc atg ccg gag ctc gtt cca atg gac acc				691
Ser Thr Asn Gly Leu Val Ser Met Pro Glu Leu Val Pro Met Asp Thr				
	185	190	195	
cag atc tgg cta cag gaa gcc aca ttc tca ctc ggg tca cca ctc ttt				739
Gln Ile Trp Leu Gln Glu Ala Thr Phe Ser Leu Gly Ser Pro Leu Phe				
	200	205	210	
gac atc gca ttg atc att gtc gcc gct ggc ttg ttc ttg tac ttc tgg				787
Asp Ile Ala Leu Ile Ile Val Ala Ala Gly Leu Phe Leu Tyr Phe Trp				
	215	220	225	
aac aaa cga caa aag cga aaa gaa gaa gct cag cga ccc aaa gaa agt				835
Asn Lys Arg Gln Lys Arg Lys Glu Glu Ala Gln Arg Pro Lys Glu Ser				
	230	235	240	245
gga tgg gtt att aac cct cgc taattattag ttttggagcgg agg				879
Gly Trp Val Ile Asn Pro Arg				
	250			

&lt;210&gt; 66

&lt;211&gt; 252

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 66

Met	Ile	Leu	His	Gly	Val	Val	Phe	Tyr	Ala	Gly	Leu	Leu	Val	Leu	Leu
1				5					10					15	

Val Pro Leu Gly Leu Gly Ala Gly Ile Leu Gly Glu Leu Phe Ile Thr

20										25					30															
Gln	Arg	Gln	Thr	Ile	Ile	Val	Val	Ser	Ser	Ile	Val	Leu	Ile	Ile	Leu															
		35					40					45																		
Gly	Phe	Val	Gln	Ile	Phe	Gly	Gly	Gly	Phe	Asp	Phe	Gly	Lys	Ala	Leu															
	50					55					60																			
Pro	Gly	Leu	Asp	Arg	Leu	Gln	Ser	Lys	Ala	Thr	Val	Thr	Ser	Gly	Leu															
65					70					75					80															
Gly	Lys	Ser	Phe	Leu	Leu	Gly	Met	Thr	Ser	Ser	Ile	Ala	Gly	Phe	Cys															
				85				90						95																
Ser	Gly	Pro	Ile	Leu	Gly	Ala	Val	Leu	Thr	Leu	Ala	Ala	Thr	Ser	Gly															
			100					105					110																	
Asn	Ser	Ile	Thr	Ser	Ala	Leu	Ile	Leu	Ser	Ala	Tyr	Gly	Ala	Gly	Met															
		115					120					125																		
Val	Leu	Pro	Leu	Met	Ala	Ile	Ala	Ala	Leu	Trp	Ala	Lys	Leu	Gly	Gln															
	130					135					140																			
Arg	Gly	Gln	Gln	Met	Leu	Arg	Gly	Arg	Glu	Phe	Thr	Phe	Leu	Gly	Arg															
145					150					155					160															
Gln	Trp	His	Ile	Val	Ser	Val	Ile	Ser	Gly	Ala	Leu	Ile	Ile	Ala	Val															
				165					170					175																
Gly	Ile	Leu	Phe	Trp	Ser	Thr	Asn	Gly	Leu	Val	Ser	Met	Pro	Glu	Leu															
			180					185					190																	
Val	Pro	Met	Asp	Thr	Gln	Ile	Trp	Leu	Gln	Glu	Ala	Thr	Phe	Ser	Leu															
		195					200					205																		
Gly	Ser	Pro	Leu	Phe	Asp	Ile	Ala	Leu	Ile	Ile	Val	Ala	Ala	Gly	Leu															
	210					215					220																			
Phe	Leu	Tyr	Phe	Trp	Asn	Lys	Arg	Gln	Lys	Arg	Lys	Glu	Glu	Ala	Gln															
225					230					235					240															
Arg	Pro	Lys	Glu	Ser	Gly	Trp	Val	Ile	Asn	Pro	Arg																			
				245					250																					

&lt;210&gt; 67

&lt;211&gt; 744

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(721)

&lt;223&gt; RXN00380

&lt;400&gt; 67

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cgtg	cattac	aacga	accag	ctcagg	agat	ttgat	cactc	gtg	cgt	ttg	acc	aaa				115
								Val	Arg	Leu	Thr	Lys				
								1				5				
cta	gca	gca	aca	atc	ggc	tgc	gtg	aca	ctc	agc	gga	ctt	gcg	cta	gta	163
Leu	Ala	Ala	Thr	Ile	Gly	Cys	Val	Thr	Leu	Ser	Gly	Leu	Ala	Leu	Val	
				10					15					20		
gcc	tgc	agc	agt	gac	agt	acc	gct	ggc	act	gac	gct	gtt	gct	gtc	ggc	211
Ala	Cys	Ser	Ser	Asp	Ser	Thr	Ala	Gly	Thr	Asp	Ala	Val	Ala	Val	Gly	
			25					30					35			
gga	acc	ttc	caa	ttc	cac	tcc	ccg	gat	gga	aag	atg	gaa	att	ttc	tac	259
Gly	Thr	Phe	Gln	Phe	His	Ser	Pro	Asp	Gly	Lys	Met	Glu	Ile	Phe	Tyr	
		40					45					50				
gac	gag	gct	gac	cgt	caa	caa	ctc	ccc	gac	att	ggc	gga	gat	tcc	ctc	307
Asp	Glu	Ala	Asp	Arg	Gln	Gln	Leu	Pro	Asp	Ile	Gly	Gly	Asp	Ser	Leu	
	55					60					65					
atg	gaa	gag	ggc	aca	cag	atc	aac	ctg	tct	gat	ttc	gaa	aac	caa	gtt	355
Met	Glu	Glu	Gly	Thr	Gln	Ile	Asn	Leu	Ser	Asp	Phe	Glu	Asn	Gln	Val	
70					75					80					85	
gtc	atc	ctc	aat	gcg	tgg	ggg	cag	tgg	tgt	gca	ccg	tgc	cgc	tcc	gaa	403
Val	Ile	Leu	Asn	Ala	Trp	Gly	Gln	Trp	Cys	Ala	Pro	Cys	Arg	Ser	Glu	
				90					95					100		
tcc	gat	gat	ctc	cag	att	atc	cat	gag	gaa	ctc	caa	gct	gcc	gga	aac	451
Ser	Asp	Asp	Leu	Gln	Ile	Ile	His	Glu	Glu	Leu	Gln	Ala	Ala	Gly	Asn	
			105					110					115			
ggc	gac	acc	cct	ggc	ggc	acc	gtg	ttg	ggc	atc	aat	gtg	cgt	gat	tac	499
Gly	Asp	Thr	Pro	Gly	Gly	Thr	Val	Leu	Gly	Ile	Asn	Val	Arg	Asp	Tyr	
		120					125					130				
tcc	cgc	gac	atc	gcc	caa	gac	ttt	gtc	acc	gac	aac	ggc	ctt	gat	tac	547
Ser	Arg	Asp	Ile	Ala	Gln	Asp	Phe	Val	Thr	Asp	Asn	Gly	Leu	Asp	Tyr	
	135					140					145					
cca	agc	att	tac	gat	cca	cca	ttt	atg	aca	gca	gca	tcc	ctc	ggc	ggc	595
Pro	Ser	Ile	Tyr	Asp	Pro	Pro	Phe	Met	Thr	Ala	Ala	Ser	Leu	Gly	Gly	
150					155					160					165	
gtt	ccc	gca	tgc	gtg	atc	cca	acc	acc	atc	gtg	ctg	gat	aaa	cag	cac	643
Val	Pro	Ala	Ser	Val	Ile	Pro	Thr	Thr	Ile	Val	Leu	Asp	Lys	Gln	His	
				170					175					180		
cgc	ccc	gca	gca	gtg	ttc	ttg	cgc	gaa	gtc	acc	tcc	aaa	gat	gtg	ttg	691
Arg	Pro	Ala	Ala	Val	Phe	Leu	Arg	Glu	Val	Thr	Ser	Lys	Asp	Val	Leu	
			185					190					195			
gat	gtt	gcg	ttg	cca	ttg	gta	gat	gag	gcc	taa	atgtctg	agattgtggc				741

agc

744

<210> 68  
 <211> 207  
 <212> PRT  
 <213> Corynebacterium glutamicum

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 Gly Leu Ala Leu Val Ala Cys Ser Ser Asp Ser Thr Ala Gly Thr Asp  
                   20                  25                  30  
 Ala Val Ala Val Gly Gly Thr Phe Gln Phe His Ser Pro Asp Gly Lys  
                   35                  40                  45  
 Met Glu Ile Phe Tyr Asp Glu Ala Asp Arg Gln Gln Leu Pro Asp Ile  
   50                  55                  60  
 Gly Gly Asp Ser Leu Met Glu Glu Gly Thr Gln Ile Asn Leu Ser Asp  
   65                  70                  75                  80  
 Phe Glu Asn Gln Val Val Ile Leu Asn Ala Trp Gly Gln Trp Cys Ala  
                   85                  90                  95  
 Pro Cys Arg Ser Glu Ser Asp Asp Leu Gln Ile Ile His Glu Glu Leu  
                   100                  105                  110  
 Gln Ala Ala Gly Asn Gly Asp Thr Pro Gly Gly Thr Val Leu Gly Ile  
                   115                  120                  125  
 Asn Val Arg Asp Tyr Ser Arg Asp Ile Ala Gln Asp Phe Val Thr Asp  
   130                  135                  140  
 Asn Gly Leu Asp Tyr Pro Ser Ile Tyr Asp Pro Pro Phe Met Thr Ala  
   145                  150                  155                  160  
 Ala Ser Leu Gly Gly Val Pro Ala Ser Val Ile Pro Thr Thr Ile Val  
                   165                  170                  175  
 Leu Asp Lys Gln His Arg Pro Ala Ala Val Phe Leu Arg Glu Val Thr  
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 Ser Lys Asp Val Leu Asp Val Ala Leu Pro Leu Val Asp Glu Ala  
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<210> 69  
 <211> 495  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(472)

&lt;223&gt; RXN00937

&lt;400&gt; 69

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tctatatata gaccttaca atcttgaacg gagattctta atg gca acc atc gat 115  
 Met Ala Thr Ile Asp  
 1 5

gta acc gaa gaa aca ttt gag agc aca gtt acc ggc gac gga att gtc 163  
 Val Thr Glu Glu Thr Phe Glu Ser Thr Val Thr Gly Asp Gly Ile Val  
 10 15 20

ctc gta gac gca tgg gca tcc tgg tgc gga cct tgc cgc cag ttc gcc 211  
 Leu Val Asp Ala Trp Ala Ser Trp Cys Gly Pro Cys Arg Gln Phe Ala  
 25 30 35

cca acc tac gag aag gtt tcc gaa acc cac acc gac gca acc ttc gcc 259  
 Pro Thr Tyr Glu Lys Val Ser Glu Thr His Thr Asp Ala Thr Phe Ala  
 40 45 50

aag ctt gat acc gaa gca aac cag ggc ctg gct gca gca ctg cag atc 307  
 Lys Leu Asp Thr Glu Ala Asn Gln Gly Leu Ala Ala Ala Leu Gln Ile  
 55 60 65

cag tcc atc cca act ctg atg gtt ttc cgc gac ggc atc atg gtc tac 355  
 Gln Ser Ile Pro Thr Leu Met Val Phe Arg Asp Gly Ile Met Val Tyr  
 70 75 80 85

cgc gaa gcc ggc acc atg cca gct cct gca ctg gat gat ctg gtc aac 403  
 Arg Glu Ala Gly Thr Met Pro Ala Pro Ala Leu Asp Asp Leu Val Asn  
 90 95 100

cag gtt aag gca ctc gac atg gat gac gtt cgt cgc cag gtc gca gag 451  
 Gln Val Lys Ala Leu Asp Met Asp Asp Val Arg Arg Gln Val Ala Glu  
 105 110 115

cag cag ggt tct gca gag gca taagcttcca attgtgtttt ggt 495  
 Gln Gln Gly Ser Ala Glu Ala  
 120

&lt;210&gt; 70

&lt;211&gt; 124

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 70

Met Ala Thr Ile Asp Val Thr Glu Glu Thr Phe Glu Ser Thr Val Thr  
 1 5 10 15

Gly Asp Gly Ile Val Leu Val Asp Ala Trp Ala Ser Trp Cys Gly Pro  
 20 25 30

Cys Arg Gln Phe Ala Pro Thr Tyr Glu Lys Val Ser Glu Thr His Thr  
 35 40 45

Asp Ala Thr Phe Ala Lys Leu Asp Thr Glu Ala Asn Gln Gly Leu Ala  
 50 55 60

Ala Ala Leu Gln Ile Gln Ser Ile Pro Thr Leu Met Val Phe Arg Asp  
 65 70 75 80

Gly Ile Met Val Tyr Arg Glu Ala Gly Thr Met Pro Ala Pro Ala Leu  
 85 90 95

Asp Asp Leu Val Asn Gln Val Lys Ala Leu Asp Met Asp Asp Val Arg  
 100 105 110

Arg Gln Val Ala Glu Gln Gln Gly Ser Ala Glu Ala  
 115 120

<210> 71  
 <211> 990  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(967)  
 <223> RXN02325

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tgcacccgtc taatgaaaat cattactatt aggtgtcatg atg gac cat gca cac 115  
 Met Asp His Ala His  
 1 5

gat tcc tgc tca cca act ctg cgc cgt gat ttg gag gtc act ggc cag 163  
 Asp Ser Cys Ser Pro Thr Leu Arg Arg Asp Leu Glu Val Thr Gly Gln  
 10 15 20

ctc caa cct gag aaa gct gtc gat tta gca gcg ccg cac gaa ggg aag 211  
 Leu Gln Pro Glu Lys Ala Val Asp Leu Ala Ala Pro His Glu Gly Lys  
 25 30 35

gtt gcc aat ata acg aag gtg acc tcc tca aat atg gag cac acc atc 259  
 Val Ala Asn Ile Thr Lys Val Thr Ser Ser Asn Met Glu His Thr Ile  
 40 45 50

acg cag gcc tca aaa gct aag gag gtg gtg gtg ctc att ggt cac tcc 307  
 Thr Gln Ala Ser Lys Ala Lys Glu Val Val Val Leu Ile Gly His Ser  
 55 60 65

ctg ctg ccc aca ttt cag gat ttg gaa aaa gac att ctg cac ttt cag 355  
 Leu Leu Pro Thr Phe Gln Asp Leu Glu Lys Asp Ile Leu His Phe Gln  
 70 75 80 85

gca ggt aat aaa ggg cga ttt tct gta gcg att gtt gat cct gat cgc 403  
 Ala Gly Asn Lys Gly Arg Phe Ser Val Ala Ile Val Asp Pro Asp Arg  
 90 95 100

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agt gca gat gtg gtt gcc aga ttt agg cca aaa cag att ccg gtg gca 451
Ser Ala Asp Val Val Ala Arg Phe Arg Pro Lys Gln Ile Pro Val Ala
      105                      110                      115

tac gtg gtg aaa gat ggc gcc agc att gcg gag ttc aac tcg ctc aac 499
Tyr Val Val Lys Asp Gly Ala Ser Ile Ala Glu Phe Asn Ser Leu Asn
      120                      125                      130

aag gag ccg gtt gca caa tgg ctt gat cat ttt gtg tcg cgg gaa acg 547
Lys Glu Pro Val Ala Gln Trp Leu Asp His Phe Val Ser Arg Glu Thr
      135                      140                      145

atc ccc aat gaa aaa gag ggg gac gtc gat aag caa ata gac ccg cgc 595
Ile Pro Asn Glu Lys Glu Gly Asp Val Asp Lys Gln Ile Asp Pro Arg
      150                      155                      160                      165

ctg tgg cgg gca gcg gaa ttg gtg aac gcc ggt gat ttt cgc gcg gcg 643
Leu Trp Arg Ala Ala Glu Leu Val Asn Ala Gly Asp Phe Arg Ala Ala
      170                      175                      180

ttg gcg ttg tat gag cag ttg ccg cag gat gcg acg gtg aag cgg gcg 691
Leu Ala Leu Tyr Glu Gln Leu Pro Gln Asp Ala Thr Val Lys Arg Ala
      185                      190                      195

cac gcg gcg gtg tcg gta ttg gcg cgg atg tct gtg gcg gat cgg gga 739
His Ala Ala Val Ser Val Leu Ala Arg Met Ser Val Ala Asp Arg Gly
      200                      205                      210

gag gat ccg atc gag aag tcg cgc cgg gat cca gac gat gtg aac aag 787
Glu Asp Pro Ile Glu Lys Ser Arg Arg Asp Pro Asp Asp Val Asn Lys
      215                      220                      225

gcg ctg gcg gcg gcg gat atg tat gtg ttg atg aat cag ccg gac aca 835
Ala Leu Ala Ala Ala Asp Met Tyr Val Leu Met Asn Gln Pro Asp Thr
      230                      235                      240                      245

gcg ctc gcg cac ctt gca gca cta ttg cca aaa ccg gag gct gcc cgg 883
Ala Leu Ala His Leu Ala Ala Leu Leu Pro Lys Pro Glu Ala Ala Arg
      250                      255                      260

cgg atc gtg gag ttg ctg aac ttg ttt gat ccg ctg gac ctg gtc gca 931
Arg Ile Val Glu Leu Leu Asn Leu Phe Asp Pro Leu Asp Leu Val Ala
      265                      270                      275

ttg gaa atc agg gcg cag gtg ggg aat gca atg agc taagaaaaca 977
Leu Glu Ile Arg Ala Gln Val Gly Asn Ala Met Ser
      280                      285

ctttaaatat tct 990

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&lt;210&gt; 72

&lt;211&gt; 289

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 72

Met Asp His Ala His Asp Ser Cys Ser Pro Thr Leu Arg Arg Asp Leu  
 1 5 10 15  
 Glu Val Thr Gly Gln Leu Gln Pro Glu Lys Ala Val Asp Leu Ala Ala  
 20 25 30  
 Pro His Glu Gly Lys Val Ala Asn Ile Thr Lys Val Thr Ser Ser Asn  
 35 40 45  
 Met Glu His Thr Ile Thr Gln Ala Ser Lys Ala Lys Glu Val Val Val  
 50 55 60  
 Leu Ile Gly His Ser Leu Leu Pro Thr Phe Gln Asp Leu Glu Lys Asp  
 65 70 75 80  
 Ile Leu His Phe Gln Ala Gly Asn Lys Gly Arg Phe Ser Val Ala Ile  
 85 90 95  
 Val Asp Pro Asp Arg Ser Ala Asp Val Val Ala Arg Phe Arg Pro Lys  
 100 105 110  
 Gln Ile Pro Val Ala Tyr Val Val Lys Asp Gly Ala Ser Ile Ala Glu  
 115 120 125  
 Phe Asn Ser Leu Asn Lys Glu Pro Val Ala Gln Trp Leu Asp His Phe  
 130 135 140  
 Val Ser Arg Glu Thr Ile Pro Asn Glu Lys Glu Gly Asp Val Asp Lys  
 145 150 155 160  
 Gln Ile Asp Pro Arg Leu Trp Arg Ala Ala Glu Leu Val Asn Ala Gly  
 165 170 175  
 Asp Phe Arg Ala Ala Leu Ala Leu Tyr Glu Gln Leu Pro Gln Asp Ala  
 180 185 190  
 Thr Val Lys Arg Ala His Ala Ala Val Ser Val Leu Ala Arg Met Ser  
 195 200 205  
 Val Ala Asp Arg Gly Glu Asp Pro Ile Glu Lys Ser Arg Arg Asp Pro  
 210 215 220  
 Asp Asp Val Asn Lys Ala Leu Ala Ala Ala Asp Met Tyr Val Leu Met  
 225 230 235 240  
 Asn Gln Pro Asp Thr Ala Leu Ala His Leu Ala Ala Leu Leu Pro Lys  
 245 250 255  
 Pro Glu Ala Ala Arg Arg Ile Val Glu Leu Leu Asn Leu Phe Asp Pro  
 260 265 270  
 Leu Asp Leu Val Ala Leu Glu Ile Arg Ala Gln Val Gly Asn Ala Met  
 275 280 285

Ser



<210> 73  
 <211> 900  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(877)  
 <223> RXN01837

<400> 73

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cccccatcat tccctcaagg tgtgaagata cggtaggat agaaaagaat ttttttgacg 60

ttggacattc tcaaaatcaa gtagcaaggg atcaaactct gtg agt act aat aag 115
                               Val Ser Thr Asn Lys
                               1                               5

gaa cga cgc caa cag gcg ctt tcc cag ctg gag aaa gaa atc aaa agc 163
Glu Arg Arg Gln Gln Ala Leu Ser Gln Leu Glu Lys Glu Ile Lys Ser
                               10                               15                               20

cgg gac cgc aaa gaa aag acc aag cca cta acc gtg gtc ttt gct tcc 211
Arg Asp Arg Lys Glu Lys Thr Lys Pro Leu Thr Val Val Phe Ala Ser
                               25                               30                               35

ctg gct gtc atc ctg gtt gtc gtt ggc ggt atc tgg tac gca gct acc 259
Leu Ala Val Ile Leu Val Val Val Gly Gly Ile Trp Tyr Ala Ala Thr
                               40                               45                               50

cgc agc acc gaa gac gaa gtc atc acc gct gat gaa aca tcc acc acc 307
Arg Ser Thr Glu Asp Glu Val Ile Thr Ala Asp Glu Thr Ser Thr Thr
                               55                               60                               65

gca gag acc cct gac tac cag cca ctg gcg ctg acc cgc acc acc gcg 355
Ala Glu Thr Pro Asp Tyr Gln Pro Leu Ala Leu Thr Arg Thr Thr Ala
                               70                               75                               80                               85

ctc ggc gac tcc gtg acc tgt gag tac cca gat gct ggc gag gct tcc 403
Leu Gly Asp Ser Val Thr Cys Glu Tyr Pro Asp Ala Gly Glu Ala Ser
                               90                               95                               100

aag gat gtc tcc aag cct gct act gaa aac gtg cca gca acc ggc acc 451
Lys Asp Val Ser Lys Pro Ala Thr Glu Asn Val Pro Ala Thr Gly Thr
                               105                               110                               115

gtg acc gtc aac ctg acc acc gcc cag ggc aac atc ggc atg gaa ctt 499
Val Thr Val Asn Leu Thr Thr Ala Gln Gly Asn Ile Gly Met Glu Leu
                               120                               125                               130

gat cgc tcc gta tcc cct tgt acc gtc aac gct gtt gag cac atg gct 547
Asp Arg Ser Val Ser Pro Cys Thr Val Asn Ala Val Glu His Met Ala
                               135                               140                               145

tcc gag ggc tac tac aac gat act gtc tgc cac cgc atc acc acc tct 595
Ser Glu Gly Tyr Tyr Asn Asp Thr Val Cys His Arg Ile Thr Thr Ser
150                               155                               160                               165

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ggc att tac gtt ctc cag tgc ggc gat cca agc agc acc ggc gca ggc 643  
 Gly Ile Tyr Val Leu Gln Cys Gly Asp Pro Ser Ser Thr Gly Ala Gly  
 170 175 180

ggc cca ggg ttc agc ttc gcc aac gaa tac cca acc gac gaa gca act 691  
 Gly Pro Gly Phe Ser Phe Ala Asn Glu Tyr Pro Thr Asp Glu Ala Thr  
 185 190 195

gac cta acc acc cca gtc atc tac gag cgc ggc acc atc gcc atg gcc 739  
 Asp Leu Thr Thr Pro Val Ile Tyr Glu Arg Gly Thr Ile Ala Met Ala  
 200 205 210

aac gct ggc gct gac acc aac ggg ctc cca gtt ctt cct caa cta cga 787  
 Asn Ala Gly Ala Asp Thr Asn Gly Leu Pro Val Leu Pro Gln Leu Arg  
 215 220 225

gga ttc ccc act ggc acc gaa cta cac cta ctt cgg cca gat cac cga 835  
 Gly Phe Pro Thr Gly Thr Glu Leu His Leu Leu Arg Pro Asp His Arg  
 230 235 240 245

aga agg cct tgc aac cct cga cgc cat cgc aga agt tgg cac 877  
 Arg Arg Pro Cys Asn Pro Arg Arg His Arg Arg Ser Trp His  
 250 255

tgaaggtgga accggcgacg gag 900

&lt;210&gt; 74

&lt;211&gt; 259

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 74

Val Ser Thr Asn Lys Glu Arg Arg Gln Gln Ala Leu Ser Gln Leu Glu  
 1 5 10 15

Lys Glu Ile Lys Ser Arg Asp Arg Lys Glu Lys Thr Lys Pro Leu Thr  
 20 25 30

Val Val Phe Ala Ser Leu Ala Val Ile Leu Val Val Val Gly Gly Ile  
 35 40 45

Trp Tyr Ala Ala Thr Arg Ser Thr Glu Asp Glu Val Ile Thr Ala Asp  
 50 55 60

Glu Thr Ser Thr Thr Ala Glu Thr Pro Asp Tyr Gln Pro Leu Ala Leu  
 65 70 75 80

Thr Arg Thr Thr Ala Leu Gly Asp Ser Val Thr Cys Glu Tyr Pro Asp  
 85 90 95

Ala Gly Glu Ala Ser Lys Asp Val Ser Lys Pro Ala Thr Glu Asn Val  
 100 105 110

Pro Ala Thr Gly Thr Val Thr Val Asn Leu Thr Thr Ala Gln Gly Asn  
 115 120 125

Ile Gly Met Glu Leu Asp Arg Ser Val Ser Pro Cys Thr Val Asn Ala  
 130 135 140  
 Val Glu His Met Ala Ser Glu Gly Tyr Tyr Asn Asp Thr Val Cys His  
 145 150 155 160  
 Arg Ile Thr Thr Ser Gly Ile Tyr Val Leu Gln Cys Gly Asp Pro Ser  
 165 170 175  
 Ser Thr Gly Ala Gly Gly Pro Gly Phe Ser Phe Ala Asn Glu Tyr Pro  
 180 185 190  
 Thr Asp Glu Ala Thr Asp Leu Thr Thr Pro Val Ile Tyr Glu Arg Gly  
 195 200 205  
 Thr Ile Ala Met Ala Asn Ala Gly Ala Asp Thr Asn Gly Leu Pro Val  
 210 215 220  
 Leu Pro Gln Leu Arg Gly Phe Pro Thr Gly Thr Glu Leu His Leu Leu  
 225 230 235 240  
 Arg Pro Asp His Arg Arg Arg Pro Cys Asn Pro Arg Arg His Arg Arg  
 245 250 255

Ser Trp His

<210> 75  
 <211> 741  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (1)..(741)  
 <223> RXN01926

<400> 75  
 ctg cga agc ttc tac acc cca gaa caa gcc atc gaa cgc gaa ggc gac 48  
 Leu Arg Ser Phe Tyr Thr Pro Glu Gln Ala Ile Glu Arg Glu Gly Asp  
 1 5 10 15  
 gtc tgg aaa gcc gcc acc gaa gaa gca gaa ctc ctc gca gct gac ggc 96  
 Val Trp Lys Ala Ala Thr Glu Glu Ala Glu Leu Leu Ala Ala Asp Gly  
 20 25 30  
 gcc gtc cac gac cag gaa ctc ttc ctc aac tgc acc acc tcc cca ctg 144  
 Ala Val His Asp Gln Glu Leu Phe Leu Asn Cys Thr Thr Ser Pro Leu  
 35 40 45  
 atc ttc gcc tcc gcg atg ctc aac ttc ggc gtc cac caa atc ctg gac 192  
 Ile Phe Ala Ser Ala Met Leu Asn Phe Gly Val His Gln Ile Leu Asp  
 50 55 60  
 acc ctc tgc caa ctc gca cca tcc ccc gcc ggc cgc gac gca gac ccc 240

Thr	Leu	Cys	Gln	Leu	Ala	Pro	Ser	Pro	Ala	Gly	Arg	Asp	Ala	Asp	Pro	
65					70					75					80	
aaa gcc ctc gaa gcc gcc acc tcc gca atg gac gac cac cgc gac acc	288															
Lys Ala Leu Glu Ala Ala Thr Ser Ala Met Asp Asp His Arg Asp Thr																
	85								90					95		
acc gac gac ttc tcc ggc gtc gtc ttc aaa gtc caa gcc ggc atg gac	336															
Thr Asp Asp Phe Ser Gly Val Val Phe Lys Val Gln Ala Gly Met Asp																
	100							105					110			
aaa aac cac cgc gat acc ctc gcc ttc atg cgc gtc gtc tcc ggc gaa	384															
Lys Asn His Arg Asp Thr Leu Ala Phe Met Arg Val Val Ser Gly Glu																
	115						120					125				
ttc gac cgc ggc atg caa gtc acc cac tcc caa tcc ggc cgc agc ttc	432															
Phe Asp Arg Gly Met Gln Val Thr His Ser Gln Ser Gly Arg Ser Phe																
	130					135				140						
tcc acc aaa tac gcc ctc acc gtc ttc ggc cgc acc cgc tct acc gtc	480															
Ser Thr Lys Tyr Ala Leu Thr Val Phe Gly Arg Thr Arg Ser Thr Val																
	145				150				155				160			
gaa acc gcc ttc ccc ggc gac atc gtc ggc ctc gtc aac gcc ggc gcc	528															
Glu Thr Ala Phe Pro Gly Asp Ile Val Gly Leu Val Asn Ala Gly Ala																
	165						170					175				
ctc gca cca ggc gac acc atc ttc gaa ggc cga aaa atc caa tac cca	576															
Leu Ala Pro Gly Asp Thr Ile Phe Glu Gly Arg Lys Ile Gln Tyr Pro																
	180						185					190				
cca atg cca aaa ttc gcg cca gaa cac ttc cgc atc ctg cgc gcc aaa	624															
Pro Met Pro Lys Phe Ala Pro Glu His Phe Arg Ile Leu Arg Ala Lys																
	195					200				205						
tca ctc ggc aaa tac aaa cag ttc cgc aaa gcc ctc gag cag ctg gac	672															
Ser Leu Gly Lys Tyr Lys Gln Phe Arg Lys Ala Leu Glu Gln Leu Asp																
	210				215				220							
tcc gaa ggt gtc gtc cag atc ctc aag aac gac ctg cgt ggc gac gcc	720															
Ser Glu Gly Val Val Gln Ile Leu Lys Asn Asp Leu Arg Gly Asp Ala																
	225				230			235			240					
aac cca ggt cat ggc cgg tgt	741															
Asn Pro Gly His Gly Arg Cys																
	245															

&lt;210&gt; 76

&lt;211&gt; 247

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 76

Leu	Arg	Ser	Phe	Tyr	Thr	Pro	Glu	Gln	Ala	Ile	Glu	Arg	Glu	Gly	Asp
1					5				10					15	

Val Trp Lys Ala Ala Thr Glu Glu Ala Glu Leu Leu Ala Ala Asp Gly  
                   20                  25                  30  
 Ala Val His Asp Gln Glu Leu Phe Leu Asn Cys Thr Thr Ser Pro Leu  
                   35                  40                  45  
 Ile Phe Ala Ser Ala Met Leu Asn Phe Gly Val His Gln Ile Leu Asp  
           50                  55                  60  
 Thr Leu Cys Gln Leu Ala Pro Ser Pro Ala Gly Arg Asp Ala Asp Pro  
   65                  70                  75                  80  
 Lys Ala Leu Glu Ala Ala Thr Ser Ala Met Asp Asp His Arg Asp Thr  
                   85                  90                  95  
 Thr Asp Asp Phe Ser Gly Val Val Phe Lys Val Gln Ala Gly Met Asp  
           100                  105                  110  
 Lys Asn His Arg Asp Thr Leu Ala Phe Met Arg Val Val Ser Gly Glu  
           115                  120                  125  
 Phe Asp Arg Gly Met Gln Val Thr His Ser Gln Ser Gly Arg Ser Phe  
   130                  135                  140  
 Ser Thr Lys Tyr Ala Leu Thr Val Phe Gly Arg Thr Arg Ser Thr Val  
  145                  150                  155                  160  
 Glu Thr Ala Phe Pro Gly Asp Ile Val Gly Leu Val Asn Ala Gly Ala  
           165                  170                  175  
 Leu Ala Pro Gly Asp Thr Ile Phe Glu Gly Arg Lys Ile Gln Tyr Pro  
           180                  185                  190  
 Pro Met Pro Lys Phe Ala Pro Glu His Phe Arg Ile Leu Arg Ala Lys  
   195                  200                  205  
 Ser Leu Gly Lys Tyr Lys Gln Phe Arg Lys Ala Leu Glu Gln Leu Asp  
   210                  215                  220  
 Ser Glu Gly Val Val Gln Ile Leu Lys Asn Asp Leu Arg Gly Asp Ala  
  225                  230                  235                  240  
 Asn Pro Gly His Gly Arg Cys  
                   245

<210> 77  
 <211> 478  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(478)  
 <223> RXN02002

<400> 77

aagtggcaaa aaacgtttca agcaggcaac gccggcggtac aacttcgctg agctggggcg 60  
attatggccc agcgcccaca acccgctatt ctttaataccc atg agc aac gcc aat 115  
Met Ser Asn Ala Asn  
1 5  
tcc gac acc acc gcc gcc gag gca cat cgc cgc aga aca ttc gcc gta 163  
Ser Asp Thr Thr Ala Ala Glu Ala His Arg Arg Arg Thr Phe Ala Val  
10 15 20  
atc gca cac ccc gac gcc ggt aaa tcc acc ctc acc gag gca ttg gcg 211  
Ile Ala His Pro Asp Ala Gly Lys Ser Thr Leu Thr Glu Ala Leu Ala  
25 30 35  
ctg cat gca cac atc atc tcc gaa gcc ggc gcc acc cac ggc aaa gca 259  
Leu His Ala His Ile Ile Ser Glu Ala Gly Ala Thr His Gly Lys Ala  
40 45 50  
ggc cgc aaa gcc acc gtt tcc gac tgg atg gaa atg gaa aaa gac cgc 307  
Gly Arg Lys Ala Thr Val Ser Asp Trp Met Glu Met Glu Lys Asp Arg  
55 60 65  
ggc atc tcc atc gcc tcc tcc gca ctc caa ttc gag tac gca cca gaa 355  
Gly Ile Ser Ile Ala Ser Ser Ala Leu Gln Phe Glu Tyr Ala Pro Glu  
70 75 80 85  
ggc cac gca ggc gag ccc ttc atg atc aac ctc gtg gac acc cca ggc 403  
Gly His Ala Gly Glu Pro Phe Met Ile Asn Leu Val Asp Thr Pro Gly  
90 95 100  
cac gcc gac ttc tcc gaa gac acc tac cgc gtc ctc atg gcc gtc gac 451  
His Ala Asp Phe Ser Glu Asp Thr Tyr Arg Val Leu Met Ala Val Asp  
105 110 115  
gca gca gtc atg ctt atg cac tcc gtc 478  
Ala Ala Val Met Leu Met His Ser Val  
120 125

&lt;210&gt; 78

&lt;211&gt; 126

&lt;212&gt; PRT

<213> *Corynebacterium glutamicum*

&lt;400&gt; 78

Met Ser Asn Ala Asn Ser Asp Thr Thr Ala Ala Glu Ala His Arg Arg  
1 5 10 15  
Arg Thr Phe Ala Val Ile Ala His Pro Asp Ala Gly Lys Ser Thr Leu  
20 25 30  
Thr Glu Ala Leu Ala Leu His Ala His Ile Ile Ser Glu Ala Gly Ala  
35 40 45  
Thr His Gly Lys Ala Gly Arg Lys Ala Thr Val Ser Asp Trp Met Glu  
50 55 60



Met Glu Lys Asp Arg Gly Ile Ser Ile Ala Ser Ser Ala Leu Gln Phe  
65 70 75 80

Glu Tyr Ala Pro Glu Gly His Ala Gly Glu Pro Phe Met Ile Asn Leu  
85 90 95

Val Asp Thr Pro Gly His Ala Asp Phe Ser Glu Asp Thr Tyr Arg Val  
100 105 110

Leu Met Ala Val Asp Ala Ala Val Met Leu Met His Ser Val  
115 120 125

<210> 79

<211> 1080

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1057)

<223> RXN02736

<400> 79

cagaggatta cccagcgggt acgtgggggtc caaagagcgc tgatgaaatg ctttcccgca 60

acggtcacac ctggcgcagg ccataattta ggggcaaaaa atg atc ttt gaa ctt 115  
Met Ile Phe Glu Leu  
1 5

ccg gat acc acc acc cag caa att tcc aag acc cta act cga ctg cgt 163  
Pro Asp Thr Thr Thr Gln Gln Ile Ser Lys Thr Leu Thr Arg Leu Arg  
10 15 20

gaa tcg ggc acc cag gtc acc acc ggc cga gtg ctc acc ctc atc gtg 211  
Glu Ser Gly Thr Gln Val Thr Thr Gly Arg Val Leu Thr Leu Ile Val  
25 30 35

gtc act gac tcc gaa agc gat gtc gct gca gtt acc gag tcc acc aat 259  
Val Thr Asp Ser Glu Ser Asp Val Ala Ala Val Thr Glu Ser Thr Asn  
40 45 50

gaa gcc tcg cgc gag cac cca tct cgc gtg atc att ttg gtg gtt ggc 307  
Glu Ala Ser Arg Glu His Pro Ser Arg Val Ile Ile Leu Val Val Gly  
55 60 65

gat aaa act gca gaa aac aaa gtt gac gca gaa gtc cgt atc ggt ggc 355  
Asp Lys Thr Ala Glu Asn Lys Val Asp Ala Glu Val Arg Ile Gly Gly  
70 75 80 85

gac gct ggt gct tcc gag atg atc atc atg cat ctc aac gga cct gtc 403  
Asp Ala Gly Ala Ser Glu Met Ile Ile Met His Leu Asn Gly Pro Val  
90 95 100

gct gac aag ctc cag tat gtc gtc aca cca ctg ttg ctt cct gac acc 451  
Ala Asp Lys Leu Gln Tyr Val Val Thr Pro Leu Leu Leu Pro Asp Thr  
105 110 115

ccc atc gtt gct tgg tgg cca ggt gaa tca cca aag aat cct tcc cag 499  
 Pro Ile Val Ala Trp Trp Pro Gly Glu Ser Pro Lys Asn Pro Ser Gln  
 120 125 130

gac cca att gga cgc atc gca caa cga cgc atc act gat gct ttg tac 547  
 Asp Pro Ile Gly Arg Ile Ala Gln Arg Arg Ile Thr Asp Ala Leu Tyr  
 135 140 145

gac cgt gat gac gca cta gaa gat cgt gtt gag aac tat cac cca ggt 595  
 Asp Arg Asp Asp Ala Leu Glu Asp Arg Val Glu Asn Tyr His Pro Gly  
 150 155 160 165

gat acc gac atg acg tgg gcg cgc ctt acc cag tgg cgg gga ctt gtt 643  
 Asp Thr Asp Met Thr Trp Ala Arg Leu Thr Gln Trp Arg Gly Leu Val  
 170 175 180

gcc tcc tca ttg gat cac cca cca cac agc gaa atc act tcc gtg agg 691  
 Ala Ser Ser Leu Asp His Pro Pro His Ser Glu Ile Thr Ser Val Arg  
 185 190 195

ctg acc ggt gca agc ggc agt acc tcg gtg gat ttg gct gca ggc tgg 739  
 Leu Thr Gly Ala Ser Gly Ser Thr Ser Val Asp Leu Ala Ala Gly Trp  
 200 205 210

ttg gcg cgg agg ctg aaa gtg cct gtg atc cgc gag gtg aca gat gct 787  
 Leu Ala Arg Arg Leu Lys Val Pro Val Ile Arg Glu Val Thr Asp Ala  
 215 220 225

ccc acc gtg cca acc gat gag ttt ggt act cca ctg ctg gct atc cag 835  
 Pro Thr Val Pro Thr Asp Glu Phe Gly Thr Pro Leu Leu Ala Ile Gln  
 230 235 240 245

cgc ctg gag atc gtt cgc acc acc ggc tcg atc atc atc acc atc tat 883  
 Arg Leu Glu Ile Val Arg Thr Thr Gly Ser Ile Ile Ile Thr Ile Tyr  
 250 255 260

gac gct cat acc ctt cag gta gag atg ccg gaa tcc ggc aat gcc cca 931  
 Asp Ala His Thr Leu Gln Val Glu Met Pro Glu Ser Gly Asn Ala Pro  
 265 270 275

tcg ctg gtg gct att ggt cgt cga agt gag tcc gac tgc ttg tct gag 979  
 Ser Leu Val Ala Ile Gly Arg Arg Ser Glu Ser Asp Cys Leu Ser Glu  
 280 285 290

gag ctt cgc cac atg gat cca gat ttg ggc tac cag cac gca cta tcc 1027  
 Glu Leu Arg His Met Asp Pro Asp Leu Gly Tyr Gln His Ala Leu Ser  
 295 300 305

ggc ttg tcc agc gtc aag ctg gaa acc gtc taaggagaaa tacaacacta 1077  
 Gly Leu Ser Ser Val Lys Leu Glu Thr Val  
 310 315

tgg 1080

&lt;210&gt; 80

&lt;211&gt; 319

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 80

Met Ile Phe Glu Leu Pro Asp Thr Thr Thr Gln Gln Ile Ser Lys Thr  
 1 5 10 15

Leu Thr Arg Leu Arg Glu Ser Gly Thr Gln Val Thr Thr Gly Arg Val  
 20 25 30

Leu Thr Leu Ile Val Val Thr Asp Ser Glu Ser Asp Val Ala Ala Val  
 35 40 45

Thr Glu Ser Thr Asn Glu Ala Ser Arg Glu His Pro Ser Arg Val Ile  
 50 55 60

Ile Leu Val Val Gly Asp Lys Thr Ala Glu Asn Lys Val Asp Ala Glu  
 65 70 75 80

Val Arg Ile Gly Gly Asp Ala Gly Ala Ser Glu Met Ile Ile Met His  
 85 90 95

Leu Asn Gly Pro Val Ala Asp Lys Leu Gln Tyr Val Val Thr Pro Leu  
 100 105 110

Leu Leu Pro Asp Thr Pro Ile Val Ala Trp Trp Pro Gly Glu Ser Pro  
 115 120 125

Lys Asn Pro Ser Gln Asp Pro Ile Gly Arg Ile Ala Gln Arg Arg Ile  
 130 135 140

Thr Asp Ala Leu Tyr Asp Arg Asp Asp Ala Leu Glu Asp Arg Val Glu  
 145 150 155 160

Asn Tyr His Pro Gly Asp Thr Asp Met Thr Trp Ala Arg Leu Thr Gln  
 165 170 175

Trp Arg Gly Leu Val Ala Ser Ser Leu Asp His Pro Pro His Ser Glu  
 180 185 190

Ile Thr Ser Val Arg Leu Thr Gly Ala Ser Gly Ser Thr Ser Val Asp  
 195 200 205

Leu Ala Ala Gly Trp Leu Ala Arg Arg Leu Lys Val Pro Val Ile Arg  
 210 215 220

Glu Val Thr Asp Ala Pro Thr Val Pro Thr Asp Glu Phe Gly Thr Pro  
 225 230 235 240

Leu Leu Ala Ile Gln Arg Leu Glu Ile Val Arg Thr Thr Gly Ser Ile  
 245 250 255

Ile Ile Thr Ile Tyr Asp Ala His Thr Leu Gln Val Glu Met Pro Glu  
 260 265 270

Ser Gly Asn Ala Pro Ser Leu Val Ala Ile Gly Arg Arg Ser Glu Ser

275					280					285					
Asp	Cys	Leu	Ser	Glu	Glu	Leu	Arg	His	Met	Asp	Pro	Asp	Leu	Gly	Tyr
	290					295					300				

Gln His Ala Leu Ser Gly Leu Ser Ser Val Lys Leu Glu Thr Val  
305 310 315

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<210> 81
<211> 331
<212> DNA
<213> Corynebacterium glutamicum
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<220>
<221> CDS
<222> (101)..(301)
<223> RXS03217
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<400> 81
tctgtgaagg tagatggttt gacgaggagt tccaacgact cggacgctgg tgaatcatgc 60

tggcgaacgt agcatcacct gattaggaaa aggtacaaat atg gca cag ggt act 115
Met Ala Gln Gly Thr
1 5

gtg aaa tgg ttc aac ggc gaa aag gga ttt ggt ttc atc gct ccc aac 163
Val Lys Trp Phe Asn Gly Glu Lys Gly Phe Gly Phe Ile Ala Pro Asn
10 15 20

gat ggc tcc gca gat ctc ttc gtc cac tac tct gag att cag ggc tcc 211
Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser Glu Ile Gln Gly Ser
25 30 35

ggt ttc cgt aat ctt gag gaa aac cag cca gtt gaa ttt gag gtc ggc 259
Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val Glu Phe Glu Val Gly
40 45 50

gag ggc gcc aag ggc cca cag gct cag cag gtt cgt gct ctc 301
Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val Arg Ala Leu
55 60 65

taaqtcttaa ctqctaqtta aaaattccgc 331

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<210> 82
<211> 67
<212> PRT
<213> Corynebacterium glutamicum
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<400> 82
Met Ala Gln Gly Thr Val Lys Trp Phe Asn Gly Glu Lys Gly Phe Gly
  1                   5                   10                   15
Phe Ile Ala Pro Asn Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser
          20                   25                   30
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Glu Ile Gln Gly Ser Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val  
           35                          40                          45

Glu Phe Glu Val Gly Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val  
       50                          55                          60

Arg Ala Leu  
       65

<210> 83  
 <211> 324  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(301)  
 <223> FRXA01917

<400> 83  
 tctgtgaagg tagatgggtt gacgaggagt tccaacgact cggacgctgg tgaatcatgc 60  
  
 tggcgaacgt agcatcacct gattaggaaa aggtacaaat atg gca cag ggt act 115  
   Met Ala Gln Gly Thr  
   1                          5  
  
 gtg aaa tgg ttc aac ggc gaa aag gga ttt ggt ttc atc gct ccc aac 163  
 Val Lys Trp Phe Asn Gly Glu Lys Gly Phe Gly Phe Ile Ala Pro Asn  
                           10                          15                          20  
  
 gat ggc tcc gca gat ctc ttc gtc cac tac tct gag att cag ggc tcc 211  
 Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser Glu Ile Gln Gly Ser  
                           25                          30                          35  
  
 ggt ttc cgt aat ctt gag gaa aac cag cca gtt gaa ttt gag gtc ggc 259  
 Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val Glu Phe Glu Val Gly  
           40                          45                          50  
  
 gag ggc gcc aag ggc cca cag gct cag cag gtt cgt gct ctc 301  
 Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val Arg Ala Leu  
       55                          60                          65  
  
 taagctctaa ctgctagcta aaa 324

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 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 84  
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 Phe Ile Ala Pro Asn Asp Gly Ser Ala Asp Leu Phe Val His Tyr Ser  
       20                          25                          30

Glu Ile Gln Gly Ser Gly Phe Arg Asn Leu Glu Glu Asn Gln Pro Val  
 35 40 45

Glu Phe Glu Val Gly Glu Gly Ala Lys Gly Pro Gln Ala Gln Gln Val  
 50 55 60

Arg Ala Leu  
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<210> 85  
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 <212> DNA  
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 <223> RXA02184

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 Val Pro Val Gly Thr  
 1 5  
 gtg aag tgg tac gac gcg gag cgt ggt ttc ggc ttt gtc tcc aat cca 163  
 Val Lys Trp Tyr Asp Ala Glu Arg Gly Phe Gly Phe Val Ser Asn Pro  
 10 15 20  
 ggt ggt gaa gat tgc ttc gta ggt aag caa gta ctt ccc aag gga gtc 211  
 Gly Gly Glu Asp Cys Phe Val Gly Lys Gln Val Leu Pro Lys Gly Val  
 25 30 35  
 acc gaa ttg cac aag gga cag cga atc gat ttt gac ttc gcc gca ggc 259  
 Thr Glu Leu His Lys Gly Gln Arg Ile Asp Phe Asp Phe Ala Ala Gly  
 40 45 50  
 cgt aag ggc cct caa gca ctt cga ata aag att ctt gaa act cca cgc 307  
 Arg Lys Gly Pro Gln Ala Leu Arg Ile Lys Ile Leu Glu Thr Pro Arg  
 55 60 65  
 agg cgt cca cag cac aaa tac aag cca gaa gag ctc aac gga atg atc 355  
 Arg Arg Pro Gln His Lys Tyr Lys Pro Glu Glu Leu Asn Gly Met Ile  
 70 75 80 85  
 tct gac ctc atc acg ctt cta gaa agt gga gtg caa cca ggc ctt gcc 403  
 Ser Asp Leu Ile Thr Leu Leu Glu Ser Gly Val Gln Pro Gly Leu Ala  
 90 95 100  
 aaa ggg caa tac ccg gag cac aaa gct gga gcg cag gta gca gaa att 451  
 Lys Gly Gln Tyr Pro Glu His Lys Ala Gly Ala Gln Val Ala Glu Ile  
 105 110 115  
 ctt cgc gtt gtt gcg aag gag ctt gag tct taaaacaata aggagaggat 501



Leu Arg Val Val Ala Lys Glu Leu Glu Ser  
 120 125

ccg

504

<210> 86  
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 <212> PRT  
 <213> Corynebacterium glutamicum

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 Phe Val Ser Asn Pro Gly Gly Glu Asp Cys Phe Val Gly Lys Gln Val  
 20 25 30  
 Leu Pro Lys Gly Val Thr Glu Leu His Lys Gly Gln Arg Ile Asp Phe  
 35 40 45  
 Asp Phe Ala Ala Gly Arg Lys Gly Pro Gln Ala Leu Arg Ile Lys Ile  
 50 55 60  
 Leu Glu Thr Pro Arg Arg Arg Pro Gln His Lys Tyr Lys Pro Glu Glu  
 65 70 75 80  
 Leu Asn Gly Met Ile Ser Asp Leu Ile Thr Leu Leu Glu Ser Gly Val  
 85 90 95  
 Gln Pro Gly Leu Ala Lys Gly Gln Tyr Pro Glu His Lys Ala Gly Ala  
 100 105 110  
 Gln Val Ala Glu Ile Leu Arg Val Val Ala Lys Glu Leu Glu Ser  
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 Met Ala Gln Gly Thr  
 1 5  
 gtt aag tgg ttc aac cca gag aag ggc ttc ggc ttc atc gct cct tcc 163  
 Val Lys Trp Phe Asn Pro Glu Lys Gly Phe Gly Phe Ile Ala Pro Ser  
 10 15 20

gac gga tcc gct gac gtt ttc gtc cac tac tcc gag atc gag ggc aac 211  
 Asp Gly Ser Ala Asp Val Phe Val His Tyr Ser Glu Ile Glu Gly Asn  
                   25                                  30                                  35

ggc ttc cgt acc ctc gag gag aac cag ctc gtc gag ttc gaa atc ggc 259  
 Gly Phe Arg Thr Leu Glu Glu Asn Gln Leu Val Glu Phe Glu Ile Gly  
                   40                                  45                                  50

gag ggc gct aag ggc ctt cag gct cag gct gtt cgt gca atc 301  
 Glu Gly Ala Lys Gly Leu Gln Ala Gln Ala Val Arg Ala Ile  
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taattgcatc tgagttcgaa acc 324

<210> 88

<211> 67

<212> PRT

<213> Corynebacterium glutamicum

<400> 88

Met Ala Gln Gly Thr Val Lys Trp Phe Asn Pro Glu Lys Gly Phe Gly  
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Phe Ile Ala Pro Ser Asp Gly Ser Ala Asp Val Phe Val His Tyr Ser  
                   20                                  25                                  30

Glu Ile Glu Gly Asn Gly Phe Arg Thr Leu Glu Glu Asn Gln Leu Val  
                   35                                  40                                  45

Glu Phe Glu Ile Gly Glu Gly Ala Lys Gly Leu Gln Ala Gln Ala Val  
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Arg Ala Ile  
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<210> 89

<211> 1017

<212> DNA

<213> Corynebacterium glutamicum

<220>

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<223> RXA01674

<400> 89

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cggtagacgg tactttcata tccacccata taatgttgat atg gat aat ggg tgg 115  
   Met Asp Asn Gly Trp  
   1                                  5

ccg aac ctg caa act ctc gca ctc ttt gtg gcg att gtg gaa gag ggg 163  
 Pro Asn Leu Gln Thr Leu Ala Leu Phe Val Ala Ile Val Glu Glu Gly

	10	15	20	
agc ctc ggt gcc ggt gct cga aaa gtc gga atg gcc caa cct aat gcc				211
Ser Leu Gly Ala Gly Ala Arg Lys Val Gly Met Ala Gln Pro Asn Ala				
	25	30	35	
agt cgg gct atc gca gag ctt gag gca gac atg aaa gcc gaa ttg ttg				259
Ser Arg Ala Ile Ala Glu Leu Glu Ala Asp Met Lys Ala Glu Leu Leu				
	40	45	50	
gta cgt cat cct cga gga tca cat cca aca gct gct gga ctt gcg ctt				307
Val Arg His Pro Arg Gly Ser His Pro Thr Ala Ala Gly Leu Ala Leu				
	55	60	65	
gtt gag cat tcg cgc gat ctg ctt caa tct gta caa gaa ttt act gaa				355
Val Glu His Ser Arg Asp Leu Leu Gln Ser Val Gln Glu Phe Thr Glu				
	70	75	80	85
tgg gtg aca gag gga cga act gag cag ccg ctg aaa ttg cat gtt ggg				403
Trp Val Thr Glu Gly Arg Thr Glu Gln Pro Leu Lys Leu His Val Gly				
	90	95	100	
gcc agt atg acc att gcc gag gct cta ctt cca gct tgg gtt gcg gac				451
Ala Ser Met Thr Ile Ala Glu Ala Leu Leu Pro Ala Trp Val Ala Asp				
	105	110	115	
atg cgc acg cgt ttt cct gcc tgc cgt gtc gac gtc tct gtg atg aat				499
Met Arg Thr Arg Phe Pro Ala Cys Arg Val Asp Val Ser Val Met Asn				
	120	125	130	
tct tct caa gta att gaa gcc gtc cag aaa ggg cac ttg caa cta ggt				547
Ser Ser Gln Val Ile Glu Ala Val Gln Lys Gly His Leu Gln Leu Gly				
	135	140	145	
ttt att gaa aca ccg cat gtt ccc gta cgg ctt cat gct cgt gtg gtg				595
Phe Ile Glu Thr Pro His Val Pro Val Arg Leu His Ala Arg Val Val				
	150	155	160	165
caa gag gac aag ctg att gtg gtg att tct cct aat cat gag tgg gct				643
Gln Glu Asp Lys Leu Ile Val Val Ile Ser Pro Asn His Glu Trp Ala				
	170	175	180	
aat cgc acg ggt agg atc agt ctt cgg gag ttg tcg gaa act ccg ctg				691
Asn Arg Thr Gly Arg Ile Ser Leu Arg Glu Leu Ser Glu Thr Pro Leu				
	185	190	195	
ata gtg agg gaa gtc ggc tca ggt acc cga gaa gca tta caa gaa tta				739
Ile Val Arg Glu Val Gly Ser Gly Thr Arg Glu Ala Leu Gln Glu Leu				
	200	205	210	
ctt gcg gat tat gac atg gct gag ccg att caa gtg tta aac agc aat				787
Leu Ala Asp Tyr Asp Met Ala Glu Pro Ile Gln Val Leu Asn Ser Asn				
	215	220	225	
gct gcg gta cgt gtt gtt gtt gaa gca ggg gca ggt cct gca gta ctt				835
Ala Ala Val Arg Val Val Val Glu Ala Gly Ala Gly Pro Ala Val Leu				
	230	235	240	245

ggt gaa tta gcc ttg cgt gat cat ctt gcg ctc ggc agg ctg ttg agt 883  
 Gly Glu Leu Ala Leu Arg Asp His Leu Ala Leu Gly Arg Leu Leu Ser  
                   250                                  255                                  260

gtg cca ttt gaa ggc agt gga gtt act cgt cct ctt aca gct gtg tgg 931  
 Val Pro Phe Glu Gly Ser Gly Val Thr Arg Pro Leu Thr Ala Val Trp  
                   265                                  270                                  275

agt gga ccc cgc aga ttg ccg att cta gcg gga gaa tta gtg tcc atc 979  
 Ser Gly Pro Arg Arg Leu Pro Ile Leu Ala Gly Glu Leu Val Ser Ile  
                   280                                  285                                  290

gca tcg aac cac atc tgattttgag ccctggctaa cgg 1017  
 Ala Ser Asn His Ile  
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<210> 90

<211> 298

<212> PRT

<213> Corynebacterium glutamicum

<400> 90

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Ala Gln Pro Asn Ala Ser Arg Ala Ile Ala Glu Leu Glu Ala Asp Met  
                   35                                  40                                  45

Lys Ala Glu Leu Leu Val Arg His Pro Arg Gly Ser His Pro Thr Ala  
                   50                                  55                                  60

Ala Gly Leu Ala Leu Val Glu His Ser Arg Asp Leu Leu Gln Ser Val  
   65                                  70                                  75                                  80

Gln Glu Phe Thr Glu Trp Val Thr Glu Gly Arg Thr Glu Gln Pro Leu  
                   85                                  90                                  95

Lys Leu His Val Gly Ala Ser Met Thr Ile Ala Glu Ala Leu Leu Pro  
                   100                                  105                                  110

Ala Trp Val Ala Asp Met Arg Thr Arg Phe Pro Ala Cys Arg Val Asp  
                   115                                  120                                  125

Val Ser Val Met Asn Ser Ser Gln Val Ile Glu Ala Val Gln Lys Gly  
                   130                                  135                                  140

His Leu Gln Leu Gly Phe Ile Glu Thr Pro His Val Pro Val Arg Leu  
   145                                  150                                  155                                  160

His Ala Arg Val Val Gln Glu Asp Lys Leu Ile Val Val Ile Ser Pro  
                   165                                  170                                  175

Asn His Glu Trp Ala Asn Arg Thr Gly Arg Ile Ser Leu Arg Glu Leu  
 180 185 190  
 Ser Glu Thr Pro Leu Ile Val Arg Glu Val Gly Ser Gly Thr Arg Glu  
 195 200 205  
 Ala Leu Gln Glu Leu Leu Ala Asp Tyr Asp Met Ala Glu Pro Ile Gln  
 210 215 220  
 Val Leu Asn Ser Asn Ala Ala Val Arg Val Val Val Glu Ala Gly Ala  
 225 230 235 240  
 Gly Pro Ala Val Leu Gly Glu Leu Ala Leu Arg Asp His Leu Ala Leu  
 245 250 255  
 Gly Arg Leu Leu Ser Val Pro Phe Glu Gly Ser Gly Val Thr Arg Pro  
 260 265 270  
 Leu Thr Ala Val Trp Ser Gly Pro Arg Arg Leu Pro Ile Leu Ala Gly  
 275 280 285  
 .Glu Leu Val Ser Ile Ala Ser Asn His Ile  
 290 295

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 <212> DNA  
 <213> Corynebacterium glutamicum

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 <222> (1)..(1191)  
 <223> RXA02431

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 gtg ttc caa atc gtg gaa aaa cgc gcc gga att gtc gaa cgc ctc agc 96  
 Val Phe Gln Ile Val Glu Lys Arg Ala Gly Ile Val Glu Arg Leu Ser  
 20 25 30  
 atc gat gaa ggc ttc atg gaa cca gag gct ctc gtt gga gcc acc cca 144  
 Ile Asp Glu Gly Phe Met Glu Pro Glu Ala Leu Val Gly Ala Thr Pro  
 35 40 45  
 gaa gag gtg aaa cag tgg gcg gaa gaa tta cgc gcg gaa att aaa gaa 192  
 Glu Glu Val Lys Gln Trp Ala Glu Glu Leu Arg Ala Glu Ile Lys Glu  
 50 55 60  
 gtt act ggc tta ccc tcc tcg gtt ggt gct ggc tcc ggt aag cag atc 240  
 Val Thr Gly Leu Pro Ser Ser Val Gly Ala Gly Ser Gly Lys Gln Ile  
 65 70 75 80  
 gcc aaa att ggt tca ggc gaa gca aag cca gat ggt gtg ttt gtc gtg 288

Ala	Lys	Ile	Gly	Ser	Gly	Glu	Ala	Lys	Pro	Asp	Gly	Val	Phe	Val	Val	
				85					90					95		
cca	gta	gac	aag	caa	cat	gac	ttg	ctt	gat	cca	ctt	cct	gtg	ggc	gca	336
Pro	Val	Asp	Lys	Gln	His	Asp	Leu	Leu	Asp	Pro	Leu	Pro	Val	Gly	Ala	
			100				105						110			
ctt	tgg	gga	gtg	ggt	cct	gtg	aca	ggc	tcc	aag	ctt	gcc	tca	atg	ggg	384
Leu	Trp	Gly	Val	Gly	Pro	Val	Thr	Gly	Ser	Lys	Leu	Ala	Ser	Met	Gly	
		115					120					125				
gtg	gaa	aca	att	ggt	gat	cta	gca	gcg	cta	acc	caa	aaa	gaa	gta	gaa	432
Val	Glu	Thr	Ile	Gly	Asp	Leu	Ala	Ala	Leu	Thr	Gln	Lys	Glu	Val	Glu	
	130					135					140					
atc	agc	ctc	ggt	gca	acc	atc	gga	ata	tca	ctg	tgg	aac	ctt	gcc	cga	480
Ile	Ser	Leu	Gly	Ala	Thr	Ile	Gly	Ile	Ser	Leu	Trp	Asn	Leu	Ala	Arg	
145					150					155					160	
gga	atc	gac	gac	cgc	cct	gtg	gaa	ccc	cgc	gcc	gaa	gca	aaa	cag	atc	528
Gly	Ile	Asp	Asp	Arg	Pro	Val	Glu	Pro	Arg	Ala	Glu	Ala	Lys	Gln	Ile	
				165					170					175		
tcc	caa	gag	cac	acc	tat	gaa	aaa	gac	ctc	ctc	acc	agg	caa	caa	gta	576
Ser	Gln	Glu	His	Thr	Tyr	Glu	Lys	Asp	Leu	Leu	Thr	Arg	Gln	Gln	Val	
			180					185					190			
gat	gct	gcc	atc	att	cga	tca	gcc	gaa	ggc	gca	cac	cga	cgg	ctc	ctc	624
Asp	Ala	Ala	Ile	Ile	Arg	Ser	Ala	Glu	Gly	Ala	His	Arg	Arg	Leu	Leu	
		195					200					205				
aaa	gac	gga	cgc	ggt	gcc	aga	act	gtc	agc	gtg	aaa	ctg	cgg	atg	gcc	672
Lys	Asp	Gly	Arg	Gly	Ala	Arg	Thr	Val	Ser	Val	Lys	Leu	Arg	Met	Ala	
	210					215					220					
gac	ttt	cgt	att	gag	tct	cgt	tcc	tac	acc	ttg	tcc	tat	gcc	acc	gat	720
Asp	Phe	Arg	Ile	Glu	Ser	Arg	Ser	Tyr	Thr	Leu	Ser	Tyr	Ala	Thr	Asp	
225					230					235					240	
gat	tac	gca	act	ctt	gag	gca	aca	gca	ttc	cga	ctt	gcc	cgc	tac	ccc	768
Asp	Tyr	Ala	Thr	Leu	Glu	Ala	Thr	Ala	Phe	Arg	Leu	Ala	Arg	Tyr	Pro	
				245				250						255		
gga	gaa	gta	ggc	ccc	atc	cgc	ctt	gtc	gga	gta	agt	ttt	tct	ggt	ttg	816
Gly	Glu	Val	Gly	Pro	Ile	Arg	Leu	Val	Gly	Val	Ser	Phe	Ser	Gly	Leu	
			260					265					270			
gaa	gaa	tcc	cgc	caa	gac	atc	ctc	ttc	ccg	gaa	ctt	gac	caa	caa	atc	864
Glu	Glu	Ser	Arg	Gln	Asp	Ile	Leu	Phe	Pro	Glu	Leu	Asp	Gln	Gln	Ile	
		275					280					285				
atc	gta	cca	cca	gca	ccc	gac	acc	gat	tat	gag	gta	ggc	gtg	caa	tcc	912
Ile	Val	Pro	Pro	Ala	Pro	Asp	Thr	Asp	Tyr	Glu	Val	Gly	Val	Gln	Ser	
	290					295				300						
tct	tct	agt	tcc	gaa	agt	act	caa	gtt	gaa	gcg	ccg	caa	gat	gtc	gcg	960
Ser	Ser	Ser	Ser	Glu	Ser	Thr	Gln	Val	Glu	Ala	Pro	Gln	Asp	Val	Ala	



305	310	315	320	
ttg agt atg tgg tgc gca acg caa gat gtc tac cac cca gaa tat ggc				1008
Leu Ser Met Trp Cys Ala Thr Gln Asp Val Tyr His Pro Glu Tyr Gly				
	325	330	335	
cac ggt tgg gta caa ggt gcc ggt cac ggt gtt gta tca gta cgt ttt				1056
His Gly Trp Val Gln Gly Ala Gly His Gly Val Val Ser Val Arg Phe				
	340	345	350	
gaa acc cgc agc acc aca aaa ggg cga act aaa agt ttt tcc atg gat				1104
Glu Thr Arg Ser Thr Thr Lys Gly Arg Thr Lys Ser Phe Ser Met Asp				
	355	360	365	
gac ccg gac ctc acc ccg gca gac cct cta gat agt ttg gat tgg gct				1152
Asp Pro Asp Leu Thr Pro Ala Asp Pro Leu Asp Ser Leu Asp Trp Ala				
	370	375	380	
gac tgg ttt gct gaa aat ggt gaa acg ggg gat gac gaa tagggtttca				1201
Asp Trp Phe Ala Glu Asn Gly Glu Thr Gly Asp Asp Glu				
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tcgggttttcg ggg				1214

<210> 92  
 <211> 397  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 92  
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 20 25 30  
 Ile Asp Glu Gly Phe Met Glu Pro Glu Ala Leu Val Gly Ala Thr Pro  
 35 40 45  
 Glu Glu Val Lys Gln Trp Ala Glu Glu Leu Arg Ala Glu Ile Lys Glu  
 50 55 60  
 Val Thr Gly Leu Pro Ser Ser Val Gly Ala Gly Ser Gly Lys Gln Ile  
 65 70 75 80  
 Ala Lys Ile Gly Ser Gly Glu Ala Lys Pro Asp Gly Val Phe Val Val  
 85 90 95  
 Pro Val Asp Lys Gln His Asp Leu Leu Asp Pro Leu Pro Val Gly Ala  
 100 105 110  
 Leu Trp Gly Val Gly Pro Val Thr Gly Ser Lys Leu Ala Ser Met Gly  
 115 120 125  
 Val Glu Thr Ile Gly Asp Leu Ala Ala Leu Thr Gln Lys Glu Val Glu  
 130 135 140

Ile Ser Leu Gly Ala Thr Ile Gly Ile Ser Leu Trp Asn Leu Ala Arg  
 145 150 155 160  
 Gly Ile Asp Asp Arg Pro Val Glu Pro Arg Ala Glu Ala Lys Gln Ile  
 165 170 175  
 Ser Gln Glu His Thr Tyr Glu Lys Asp Leu Leu Thr Arg Gln Gln Val  
 180 185 190  
 Asp Ala Ala Ile Ile Arg Ser Ala Glu Gly Ala His Arg Arg Leu Leu  
 195 200 205  
 Lys Asp Gly Arg Gly Ala Arg Thr Val Ser Val Lys Leu Arg Met Ala  
 210 215 220  
 Asp Phe Arg Ile Glu Ser Arg Ser Tyr Thr Leu Ser Tyr Ala Thr Asp  
 225 230 235 240  
 Asp Tyr Ala Thr Leu Glu Ala Thr Ala Phe Arg Leu Ala Arg Tyr Pro  
 245 250 255  
 Gly Glu Val Gly Pro Ile Arg Leu Val Gly Val Ser Phe Ser Gly Leu  
 260 265 270  
 Glu Glu Ser Arg Gln Asp Ile Leu Phe Pro Glu Leu Asp Gln Gln Ile  
 275 280 285  
 Ile Val Pro Pro Ala Pro Asp Thr Asp Tyr Glu Val Gly Val Gln Ser  
 290 295 300  
 Ser Ser Ser Ser Glu Ser Thr Gln Val Glu Ala Pro Gln Asp Val Ala  
 305 310 315 320  
 Leu Ser Met Trp Cys Ala Thr Gln Asp Val Tyr His Pro Glu Tyr Gly  
 325 330 335  
 His Gly Trp Val Gln Gly Ala Gly His Gly Val Val Ser Val Arg Phe  
 340 345 350  
 Glu Thr Arg Ser Thr Thr Lys Gly Arg Thr Lys Ser Phe Ser Met Asp  
 355 360 365  
 Asp Pro Asp Leu Thr Pro Ala Asp Pro Leu Asp Ser Leu Asp Trp Ala  
 370 375 380  
 Asp Trp Phe Ala Glu Asn Gly Glu Thr Gly Asp Asp Glu  
 385 390 395

&lt;210&gt; 93

&lt;211&gt; 558

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(535)

&lt;223&gt; RXA02446

&lt;400&gt; 93

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gagcgtattc tttgtgttct ctcacgacag gaatactgct atg gcg atc gag tcc 115  
 Met Ala Ile Glu Ser  
 1 5

atc gcg tac acc agt gaa gca ctc tca acc ggc agt ggc cgg ctg ggg 163  
 Ile Ala Tyr Thr Ser Glu Ala Leu Ser Thr Gly Ser Gly Arg Leu Gly  
 10 15 20

cat gtg cgc tcc aca gat ggt gcg ctc gaa ttt gaa atg aca ccg cca 211  
 His Val Arg Ser Thr Asp Gly Ala Leu Glu Phe Glu Met Thr Pro Pro  
 25 30 35

aag gct ttg ggc gga tcc ggt gaa ggc acc aat cca gaa cag ctg ttc 259  
 Lys Ala Leu Gly Gly Ser Gly Glu Gly Thr Asn Pro Glu Gln Leu Phe  
 40 45 50

gcg gta ggt tac gca gcc tgt ttc cac tct gcc atg cac tct gtc gca 307  
 Ala Val Gly Tyr Ala Ala Cys Phe His Ser Ala Met His Ser Val Ala  
 55 60 65

cgc agc cgc aag atc act ctt gaa gac aca gcg gtt ggt gcc cga gtt 355  
 Arg Ser Arg Lys Ile Thr Leu Glu Asp Thr Ala Val Gly Ala Arg Val  
 70 75 80 85

agc atc ggg cca aac ggc gct ggt gga ttt gag att gcc gta gaa ctc 403  
 Ser Ile Gly Pro Asn Gly Ala Gly Gly Phe Glu Ile Ala Val Glu Leu  
 90 95 100

gaa gta tcg att cct caa ttg cca caa gca gaa gcc cag gaa ctt gct 451  
 Glu Val Ser Ile Pro Gln Leu Pro Gln Ala Glu Ala Gln Glu Leu Ala  
 105 110 115

gat gcc gcg cac cag gtg tgc ccg tat tcc aac gcc aca cga ggc aat 499  
 Asp Ala Ala His Gln Val Cys Pro Tyr Ser Asn Ala Thr Arg Gly Asn  
 120 125 130

atc tcg gta act gtg tca gtc atc gac gaa gag gct taaaaccaca 545  
 Ile Ser Val Thr Val Ser Val Ile Asp Glu Glu Ala  
 135 140 145

ggattaacaa aac 558

&lt;210&gt; 94

&lt;211&gt; 145

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 94

Met Ala Ile Glu Ser Ile Ala Tyr Thr Ser Glu Ala Leu Ser Thr Gly  
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gaagggtatta atacttcttt aaggggcgga ggattttcgt atg tct act aga aca    115
                                Met Ser Thr Arg Thr
                                  1                               5

acg cca caa gac cgt tat acc gaç gaa tac ggc atc gaa cgc gtc aac    163
Thr Pro Gln Asp Arg Tyr Thr Asp Glu Tyr Gly Ile Glu Arg Val Asn
                        10                      15                    20

aag gat gaa ccc ggc ctg gtg gac aaa ctc cgq gac aag cac gac tgg    211
Lys Asp Glu Pro Gly Leu Val Asp Lys Leu Arg Asp Lys His Asp Trp
                       25                     30                   35

ttt gat cat ctc atg cgc atg aat gaa cgt ttc ggc gca aaa ggt ggc    259
Phe Asp His Leu Met Arg Met Asn Glu Arg Phe Gly Ala Lys Gly Gly
                40                  45                         50
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aac caa ttg tcg gcg ggt att acg tat ttc tcc gtg ctg tcg atc ttc	307
Asn Gln Leu Ser Ala Gly Ile Thr Tyr Phe Ser Val Leu Ser Ile Phe	
55 60 65	
ccg att gcc atg ctt gtc ttc ggt att gca ggt gtc atc ctt gcc gga	355
Pro Ile Ala Met Leu Val Phe Gly Ile Ala Gly Val Ile Leu Ala Gly	
70 75 80 85	
aac cct gaa gtt ctc aca gat att caa aat cga atc aac gat gct tta	403
Asn Pro Glu Val Leu Thr Asp Ile Gln Asn Arg Ile Asn Asp Ala Leu	
90 95 100	
gaa ggc gag atc ggt aac acc gtc aac ggc atc att gat tcc gcg att	451
Glu Gly Glu Ile Gly Asn Thr Val Asn Gly Ile Ile Asp Ser Ala Ile	
105 110 115	
gcg cag cgt ggt gct gtg ttg ggc att ggt ggt gta act gcc ctg tgg	499
Ala Gln Arg Gly Ala Val Leu Gly Ile Gly Gly Val Thr Ala Leu Trp	
120 125 130	
tct gga ctg ggg tgg atg gcg aac ctg cgc ttt gga gtt tcc cgc atg	547
Ser Gly Leu Gly Trp Met Ala Asn Leu Arg Phe Gly Val Ser Arg Met	
135 140 145	
tgg gcc att gac cca act gaa ggc aac ttc att caa aag aag ctc acc	595
Trp Ala Ile Asp Pro Thr Glu Gly Asn Phe Ile Gln Lys Lys Leu Thr	
150 155 160 165	
gac ttg gtc gcg ctg atc gtc ttg ctg ctg gcc atg ggc gta gcc ttc	643
Asp Leu Val Ala Leu Ile Val Leu Leu Leu Ala Met Gly Val Ala Phe	
170 175 180	
ggt atc acg gcg ctc ggt gct tcc gga cta acc aaa aac ctg ctg gac	691
Gly Ile Thr Ala Leu Gly Ala Ser Gly Leu Thr Lys Asn Leu Leu Asp	
185 190 195	
ttt gtg ggc ctg ggg gag att ccg ggc att agc tac atc acc tgg gtg	739
Phe Val Gly Leu Gly Glu Ile Pro Gly Ile Ser Tyr Ile Thr Trp Val	
200 205 210	
gtc gca gca ctt gtt ggt gtc ttg gct aac ttc ctg gtg ttc atg tgg	787
Val Ala Ala Leu Val Gly Val Leu Ala Asn Phe Leu Val Phe Met Trp	
215 220 225	
ctg att ttc tcc ctg cca cgt acc aaa gtt ccc atg aaa ccg ggt ctt	835
Leu Ile Phe Ser Leu Pro Arg Thr Lys Val Pro Met Lys Pro Gly Leu	
230 235 240 245	
cag gca gca ctg ctt ggc gca atc ggt ttt gag gtg gtc aag cag gtt	883
Gln Ala Ala Leu Leu Gly Ala Ile Gly Phe Glu Val Val Lys Gln Val	
250 255 260	
gga tcg ctg ttg gct tca aat gca ttg agt aac ccc gcg ggt gca gca	931
Gly Ser Leu Leu Ala Ser Asn Ala Leu Ser Asn Pro Ala Gly Ala Ala	
265 270 275	

ttc ggt ccg atc atc ggc atc atg gtt gtg ctg tat ttg atc tgg cgc 979  
 Phe Gly Pro Ile Ile Gly Ile Met Val Val Leu Tyr Leu Ile Trp Arg  
           280                          285                          290

atc ctc atg tat tgc tct gcg tgg gct gcc acc agt gaa gaa gcg ttg 1027  
 Ile Leu Met Tyr Cys Ser Ala Trp Ala Ala Thr Ser Glu Glu Ala Leu  
           295                          300                          305

cgt ctt gcg act gtt cca gca cca gag cct gcg atc att cgg gtt cgc 1075  
 Arg Leu Ala Thr Val Pro Ala Pro Glu Pro Ala Ile Ile Arg Val Arg  
           310                          315                          320                          325

cat gaa att gat cca ggt gaa gaa gtc tcc caa tct gct cga aaa gtg 1123  
 His Glu Ile Asp Pro Gly Glu Glu Val Ser Gln Ser Ala Arg Lys Val  
                           330                          335                          340

ggc att gga gtg gcc gtg ggt gcc gcg act gcg ggt gct ttt gcg ctg 1171  
 Gly Ile Gly Val Ala Val Gly Ala Ala Thr Ala Gly Ala Phe Ala Leu  
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ttg cgt aaa aaa tagtttttat taagggcatt ccc 1206  
 Leu Arg Lys Lys  
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<210> 96

<211> 361

<212> PRT

<213> Corynebacterium glutamicum

<400> 96

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           20                          25                          30

Asp Lys His Asp Trp Phe Asp His Leu Met Arg Met Asn Glu Arg Phe  
           35                          40                          45

Gly Ala Lys Gly Gly Asn Gln Leu Ser Ala Gly Ile Thr Tyr Phe Ser  
           50                          55                          60

Val Leu Ser Ile Phe Pro Ile Ala Met Leu Val Phe Gly Ile Ala Gly  
           65                          70                          75                          80

Val Ile Leu Ala Gly Asn Pro Glu Val Leu Thr Asp Ile Gln Asn Arg  
                           85                          90                          95

Ile Asn Asp Ala Leu Glu Gly Glu Ile Gly Asn Thr Val Asn Gly Ile  
           100                          105                          110

Ile Asp Ser Ala Ile Ala Gln Arg Gly Ala Val Leu Gly Ile Gly Gly  
           115                          120                          125

Val Thr Ala Leu Trp Ser Gly Leu Gly Trp Met Ala Asn Leu Arg Phe  
           130                          135                          140



Gly Val Ser Arg Met Trp Ala Ile Asp Pro Thr Glu Gly Asn Phe Ile  
145 150 155 160

Gln Lys Lys Leu Thr Asp Leu Val Ala Leu Ile Val Leu Leu Leu Ala  
165 170 175

Met Gly Val Ala Phe Gly Ile Thr Ala Leu Gly Ala Ser Gly Leu Thr  
180 185 190

Lys Asn Leu Leu Asp Phe Val Gly Leu Gly Glu Ile Pro Gly Ile Ser  
195 200 205

Tyr Ile Thr Trp Val Val Ala Ala Leu Val Gly Val Leu Ala Asn Phe  
210 215 220

Leu Val Phe Met Trp Leu Ile Phe Ser Leu Pro Arg Thr Lys Val Pro  
225 230 235 240

Met Lys Pro Gly Leu Gln Ala Ala Leu Leu Gly Ala Ile Gly Phe Glu  
245 250 255

Val Val Lys Gln Val Gly Ser Leu Leu Ala Ser Asn Ala Leu Ser Asn  
260 265 270

Pro Ala Gly Ala Ala Phe Gly Pro Ile Ile Gly Ile Met Val Val Leu  
275 280 285

Tyr Leu Ile Trp Arg Ile Leu Met Tyr Cys Ser Ala Trp Ala Ala Thr  
290 295 300

Ser Glu Glu Ala Leu Arg Leu Ala Thr Val Pro Ala Pro Glu Pro Ala  
305 310 315 320

Ile Ile Arg Val Arg His Glu Ile Asp Pro Gly Glu Glu Val Ser Gln  
325 330 335

Ser Ala Arg Lys Val Gly Ile Gly Val Ala Val Gly Ala Ala Thr Ala  
340 345 350

Gly Ala Phe Ala Leu Leu Arg Lys Lys  
355 360

&lt;210&gt; 97

&lt;211&gt; 753

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(730)

&lt;223&gt; RXA00981

&lt;400&gt; 97

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ggatagaagt acccccagtc cagaatgaag gtcaccacca	atg tca gag aat ttg	115
	Met Ser Glu Asn Leu	
	1 5	
cca gcg ccc gag aat ctc ctg gac gcc gag aga att cag atg atc aag		163
Pro Ala Pro Glu Asn Leu Leu Asp Ala Glu Arg Ile Gln Met Ile Lys		
	10 15 20	
aac ttc cgc aac gaa tta acg ggg ttc atg ctc aac tac caa ttt ggc		211
Asn Phe Arg Asn Glu Leu Thr Gly Phe Met Leu Asn Tyr Gln Phe Gly		
	25 30 35	
att gat gag atc ctg acc aag atc aac atc ctg aaa act gaa ttc agc		259
Ile Asp Glu Ile Leu Thr Lys Ile Asn Ile Leu Lys Thr Glu Phe Ser		
	40 45 50	
cag ctg cac gaa tac gca cct atc gag cac gta tct tca cga ttg aag		307
Gln Leu His Glu Tyr Ala Pro Ile Glu His Val Ser Ser Arg Leu Lys		
	55 60 65	
aca cca gaa agc atc gtc aaa aag gtc atc cga aaa gga gac gag ctc		355
Thr Pro Glu Ser Ile Val Lys Lys Val Ile Arg Lys Gly Asp Glu Leu		
	70 75 80 85	
tcc ctc gca gct atc aaa gac aca gtg ttt gat atc gca ggc att cga		403
Ser Leu Ala Ala Ile Lys Asp Thr Val Phe Asp Ile Ala Gly Ile Arg		
	90 95 100	
atc gtc tgc agt ttc ctc aaa gat gcc tac gca atc gcc gat atg ctg		451
Ile Val Cys Ser Phe Leu Lys Asp Ala Tyr Ala Ile Ala Asp Met Leu		
	105 110 115	
acc aac caa aaa gac gtc acg gtc atc gag gcc aaa gac tac atc gct		499
Thr Asn Gln Lys Asp Val Thr Val Ile Glu Ala Lys Asp Tyr Ile Ala		
	120 125 130	
aac cca aag ccg aac ggc tac aag agt ttg cac ctt atc ctc caa gtg		547
Asn Pro Lys Pro Asn Gly Tyr Lys Ser Leu His Leu Ile Leu Gln Val		
	135 140 145	
cct gtc ttc ctg tct aac tcc gtg gaa aag gtc aat gtt gaa gtc cag		595
Pro Val Phe Leu Ser Asn Ser Val Glu Lys Val Asn Val Glu Val Gln		
	150 155 160 165	
atc cgc acc att gcc atg gac ttc tgg gca agc ctc gag cac aaa atc		643
Ile Arg Thr Ile Ala Met Asp Phe Trp Ala Ser Leu Glu His Lys Ile		
	170 175 180	
tac tac aaa ttt gaa caa gaa gtt cct cag tca atc ctt gat gag ctc		691
Tyr Tyr Lys Phe Glu Gln Glu Val Pro Gln Ser Ile Leu Asp Glu Leu		
	185 190 195	
agt gaa gat gga aag aat cca cgg gga agt gaa gtc act taaacctcca		740
Ser Glu Asp Gly Lys Asn Pro Arg Gly Ser Glu Val Thr		
	200 205 210	
qttgaaacca ctg		753

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 <213> Corynebacterium glutamicum

<400> 98  
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                     20                    25                    30  
 Asn Tyr Gln Phe Gly Ile Asp Glu Ile Leu Thr Lys Ile Asn Ile Leu  
                     35                    40                    45  
 Lys Thr Glu Phe Ser Gln Leu His Glu Tyr Ala Pro Ile Glu His Val  
             50                    55                    60  
 Ser Ser Arg Leu Lys Thr Pro Glu Ser Ile Val Lys Lys Val Ile Arg  
     65                    70                    75                    80  
 Lys Gly Asp Glu Leu Ser Leu Ala Ala Ile Lys Asp Thr Val Phe Asp  
                     85                    90                    95  
 Ile Ala Gly Ile Arg Ile Val Cys Ser Phe Leu Lys Asp Ala Tyr Ala  
                     100                    105                    110  
 Ile Ala Asp Met Leu Thr Asn Gln Lys Asp Val Thr Val Ile Glu Ala  
             115                    120                    125  
 Lys Asp Tyr Ile Ala Asn Pro Lys Pro Asn Gly Tyr Lys Ser Leu His  
     130                    135                    140  
 Leu Ile Leu Gln Val Pro Val Phe Leu Ser Asn Ser Val Glu Lys Val  
     145                    150                    155                    160  
 Asn Val Glu Val Gln Ile Arg Thr Ile Ala Met Asp Phe Trp Ala Ser  
                     165                    170                    175  
 Leu Glu His Lys Ile Tyr Tyr Lys Phe Glu Gln Glu Val Pro Gln Ser  
                     180                    185                    190  
 Ile Leu Asp Glu Leu Ser Glu Asp Gly Lys Asn Pro Arg Gly Ser Glu  
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 Val Thr  
     210

<210> 99  
 <211> 1098  
 <212> DNA  
 <213> Corynebacterium glutamicum  
 <220>

&lt;221&gt; CDS

&lt;222&gt; (101)..(1075)

&lt;223&gt; RXN00786

&lt;400&gt; 99

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gtctaggtgt ttagcctcaa cgttggatac gctgggaggc atg agc tca cct gtt 115
                                         Met Ser Ser Pro Val
                                         1                               5

atc agc ccc gaa acc aaa acc gga aag aag atc ctg ctt gca gcc cct 163
Ile Ser Pro Glu Thr Lys Thr Gly Lys Lys Ile Leu Leu Ala Ala Pro
                        10                               15                               20

cgc gga tac tgt gcc ggc gta gac cgt gca gtg gaa acc gtc gag cgc 211
Arg Gly Tyr Cys Ala Gly Val Asp Arg Ala Val Glu Thr Val Glu Arg
                        25                               30                               35

gcg ctc gag gaa tac ggc gcc cca att tat gtc cgt aaa gaa atc gtg 259
Ala Leu Glu Glu Tyr Gly Ala Pro Ile Tyr Val Arg Lys Glu Ile Val
                        40                               45                               50

cac aac cgt tac gtt gtg gac acc ctg gca gaa aag ggc gcg att ttt 307
His Asn Arg Tyr Val Val Asp Thr Leu Ala Glu Lys Gly Ala Ile Phe
                        55                               60                               65

gtc aac gaa gca tct gaa gca cca gaa ggt gcc aac atg gtg ttc tct 355
Val Asn Glu Ala Ser Glu Ala Pro Glu Gly Ala Asn Met Val Phe Ser
                        70                               75                               80                               85

gca cac ggc gtg agc cca atg gtc cac gaa gaa gct gca gct aaa aac 403
Ala His Gly Val Ser Pro Met Val His Glu Glu Ala Ala Ala Lys Asn
                        90                               95                               100

atc aag gct att gac gcg gcc tgc ccg ctg gtc acc aaa gtg cac aag 451
Ile Lys Ala Ile Asp Ala Ala Cys Pro Leu Val Thr Lys Val His Lys
                        105                               110                               115

gaa gtc cag cgc ttt gat aag cag gga ttc cac att ctc ttc atc ggt 499
Glu Val Gln Arg Phe Asp Lys Gln Gly Phe His Ile Leu Phe Ile Gly
                        120                               125                               130

cac gaa ggc cat gaa gaa gta gag ggc acc atg ggt cat tcc gtt gag 547
His Glu Gly His Glu Glu Val Glu Gly Thr Met Gly His Ser Val Glu
                        135                               140                               145

aaa acc cac ctg gtt gac ggc gtt gct ggc att gcc acc ctg cct gaa 595
Lys Thr His Leu Val Asp Gly Val Ala Gly Ile Ala Thr Leu Pro Glu
                        150                               155                               160                               165

ttc tta aac gat gaa cca aac ctg atc tgg ctg tct cag acc acg ctt 643
Phe Leu Asn Asp Glu Pro Asn Leu Ile Trp Leu Ser Gln Thr Thr Leu
                        170                               175                               180

tct gtg gac gag acc atg gag atc gtc cgc gag ctg aag gtg aag ttc 691
Ser Val Asp Glu Thr Met Glu Ile Val Arg Glu Leu Lys Val Lys Phe

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185	190	195	
cct cag ctg cag gat cca ccg tca gat gat att tgc tac gcc acg cag Pro Gln Leu Gln Asp Pro Pro Ser Asp Asp Ile Cys Tyr Ala Thr Gln 200 205 210			739
aac cgc cag gtt gcc gtc aag gct atc gct gag cgc tgc gag ctg atg Asn Arg Gln Val Ala Val Lys Ala Ile Ala Glu Arg Cys Glu Leu Met 215 220 225			787
att gtg gtc ggt tcc cgc aac tcc tcc aac tgc gtt cgt ctg gtt gag Ile Val Val Gly Ser Arg Asn Ser Ser Asn Ser Val Arg Leu Val Glu 230 235 240 245			835
gtc gct aag caa aac ggt gcc gat aac gcc tac ctg gtg gat tac gcc Val Ala Lys Gln Asn Gly Ala Asp Asn Ala Tyr Leu Val Asp Tyr Ala 250 255 260			883
cgc gaa atc gac cca gca tgg ttc gaa ggc gta gag acc atc ggt atc Arg Glu Ile Asp Pro Ala Trp Phe Glu Gly Val Glu Thr Ile Gly Ile 265 270 275			931
tcc tcc ggc gct tcc gtg cct gag atc ctc gtc cag ggc gtc att gag Ser Ser Gly Ala Ser Val Pro Glu Ile Leu Val Gln Gly Val Ile Glu 280 285 290			979
cgc ctg gct gag ttc ggc tac gac gac gtc gag gaa gtc acc tcc gcc Arg Leu Ala Glu Phe Gly Tyr Asp Asp Val Glu Glu Val Thr Ser Ala 295 300 305			1027
gct gag aag att gtt ttc gcg ctg cct cgc gtg ctg cgc cac aag aat Ala Glu Lys Ile Val Phe Ala Leu Pro Arg Val Leu Arg His Lys Asn 310 315 320 325			1075
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&lt;210&gt; 100

&lt;211&gt; 325

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 100

Met	Ser	Ser	Pro	Val	Ile	Ser	Pro	Glu	Thr	Lys	Thr	Gly	Lys	Lys	Ile
1				5					10					15	

Leu	Leu	Ala	Ala	Pro	Arg	Gly	Tyr	Cys	Ala	Gly	Val	Asp	Arg	Ala	Val
		20						25					30		

Glu	Thr	Val	Glu	Arg	Ala	Leu	Glu	Glu	Tyr	Gly	Ala	Pro	Ile	Tyr	Val
		35					40					45			

Arg	Lys	Glu	Ile	Val	His	Asn	Arg	Tyr	Val	Val	Asp	Thr	Leu	Ala	Glu
	50					55					60				

Lys	Gly	Ala	Ile	Phe	Val	Asn	Glu	Ala	Ser	Glu	Ala	Pro	Glu	Gly	Ala
65					70					75				80	

Asn Met Val Phe Ser Ala His Gly Val Ser Pro Met Val His Glu Glu  
                     85                    90                    95  
 Ala Ala Ala Lys Asn Ile Lys Ala Ile Asp Ala Ala Cys Pro Leu Val  
                     100                    105                    110  
 Thr Lys Val His Lys Glu Val Gln Arg Phe Asp Lys Gln Gly Phe His  
                     115                    120                    125  
 Ile Leu Phe Ile Gly His Glu Gly His Glu Glu Val Glu Gly Thr Met  
                     130                    135                    140  
 Gly His Ser Val Glu Lys Thr His Leu Val Asp Gly Val Ala Gly Ile  
                     145                    150                    155                    160  
 Ala Thr Leu Pro Glu Phe Leu Asn Asp Glu Pro Asn Leu Ile Trp Leu  
                     165                    170                    175  
 Ser Gln Thr Thr Leu Ser Val Asp Glu Thr Met Glu Ile Val Arg Glu  
                     180                    185                    190  
 Leu Lys Val Lys Phe Pro Gln Leu Gln Asp Pro Pro Ser Asp Asp Ile  
                     195                    200                    205  
 Cys Tyr Ala Thr Gln Asn Arg Gln Val Ala Val Lys Ala Ile Ala Glu  
                     210                    215                    220  
 Arg Cys Glu Leu Met Ile Val Val Gly Ser Arg Asn Ser Ser Asn Ser  
                     225                    230                    235                    240  
 Val Arg Leu Val Glu Val Ala Lys Gln Asn Gly Ala Asp Asn Ala Tyr  
                     245                    250                    255  
 Leu Val Asp Tyr Ala Arg Glu Ile Asp Pro Ala Trp Phe Glu Gly Val  
                     260                    265                    270  
 Glu Thr Ile Gly Ile Ser Ser Gly Ala Ser Val Pro Glu Ile Leu Val  
                     275                    280                    285  
 Gln Gly Val Ile Glu Arg Leu Ala Glu Phe Gly Tyr Asp Asp Val Glu  
                     290                    295                    300  
 Glu Val Thr Ser Ala Ala Glu Lys Ile Val Phe Ala Leu Pro Arg Val  
                     305                    310                    315                    320  
 Leu Arg His Lys Asn  
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<210> 101  
 <211> 1131  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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&lt;222&gt; (101)..(1108)

&lt;223&gt; RXS01027

&lt;400&gt; 101

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gaactgtgtg caccacaacg cggaaggtga atcgcaccca atg gca aat aag aac 115  
 Met Ala Asn Lys Asn  
 1 5

aat aag cct cat gag gtg gac aaa gac caa gat tca gcc atg ctg atc 163  
 Asn Lys Pro His Glu Val Asp Lys Asp Gln Asp Ser Ala Met Leu Ile  
 10 15 20

aac ggt cgc ctg caa cag atc ccg gcg cgt ccc act gag gaa ttc acc 211  
 Asn Gly Arg Leu Gln Gln Ile Pro Ala Arg Pro Thr Glu Glu Phe Thr  
 25 30 35

cgc cca act ctt gca gca ggt gca gta ctg tgg cgc ggc gac atc acc 259  
 Arg Pro Thr Leu Ala Ala Gly Ala Val Leu Trp Arg Gly Asp Ile Thr  
 40 45 50

aac ccg gac agc atc gag gtc gct gtc atc cac cgc ccg cac tat gat 307  
 Asn Pro Asp Ser Ile Glu Val Ala Val Ile His Arg Pro His Tyr Asp  
 55 60 65

gac tgg tcc ctg gcc aag ggc aaa gtc gat ccc ggc gag tct att ccg 355  
 Asp Trp Ser Leu Ala Lys Gly Lys Val Asp Pro Gly Glu Ser Ile Pro  
 70 75 80 85

aca acc gcg gcc cgt gaa atc ctt gaa gaa act ggc tac gac atc cgt 403  
 Thr Thr Ala Ala Arg Glu Ile Leu Glu Glu Thr Gly Tyr Asp Ile Arg  
 90 95 100

ctg ggc aag ctg atc ggc aag gtt act tac cct gtg ctc gac cga acc 451  
 Leu Gly Lys Leu Ile Gly Lys Val Thr Tyr Pro Val Leu Asp Arg Thr  
 105 110 115

aaa gtg gtc tac tac tgg act gcc cag gtt ctt ggt gga gag ttt gtc 499  
 Lys Val Val Tyr Tyr Trp Thr Ala Gln Val Leu Gly Gly Glu Phe Val  
 120 125 130

ccc aac gat gaa gtt gat gaa atc cgt tgg ctg tct gtt gat gaa gca 547  
 Pro Asn Asp Glu Val Asp Glu Ile Arg Trp Leu Ser Val Asp Glu Ala  
 135 140 145

tgc gag ttg ctc agc tac caa gta gat acc gaa gtt ctg gcc aag gca 595  
 Cys Glu Leu Leu Ser Tyr Gln Val Asp Thr Glu Val Leu Ala Lys Ala  
 150 155 160 165

gca aag cgt ttc cgc act cct tcc acc act cgg gtg ctg tat gtt cgc 643  
 Ala Lys Arg Phe Arg Thr Pro Ser Thr Thr Arg Val Leu Tyr Val Arg  
 170 175 180

cat gct cat gca cat ggt cgc caa acc tgg ggt ggc gac gac aat aag 691  
 His Ala His Ala His Gly Arg Gln Thr Trp Gly Gly Asp Asp Asn Lys  
 185 190 195

cgc cca ttg gac aaa aag ggg cgt cga caa gca gaa atg ctc gta ccc 739  
 Arg Pro Leu Asp Lys Lys Gly Arg Arg Gln Ala Glu Met Leu Val Pro  
 200 205 210  
  
 atg ttg ttg ccc ttc aaa ccc acc gca att tac tcg gcg gtg ccc gat 787  
 Met Leu Leu Pro Phe Lys Pro Thr Ala Ile Tyr Ser Ala Val Pro Asp  
 215 220 225  
  
 cgc tgc caa gcc acc gcg ctc ccc ctt gcc gat gag ctc ggc ctc gac 835  
 Arg Cys Gln Ala Thr Ala Leu Pro Leu Ala Asp Glu Leu Gly Leu Asp  
 230 235 240 245  
  
 gtg tcc gtc aac cga ctg ttc ggc gac gac gcc tgg gaa acc gat ccc 883  
 Val Ser Val Asn Arg Leu Phe Gly Asp Asp Ala Trp Glu Thr Asp Pro  
 250 255 260  
  
 gag gcc tgc aag aag cgc ttc acc gac gtg gtc gcg caa ggt ggc gtg 931  
 Glu Ala Cys Lys Lys Arg Phe Thr Asp Val Val Ala Gln Gly Gly Val  
 265 270 275  
  
 ccg atg atc gtt ggg cag ggc gac atc att ccg gaa atg atc aaa tgg 979  
 Pro Met Ile Val Gly Gln Gly Asp Ile Ile Pro Glu Met Ile Lys Trp  
 280 285 290  
  
 ttc tcc gag aac ggc acc ctc cct atc gat gag aag atc aag gcg aaa 1027  
 Phe Ser Glu Asn Gly Thr Leu Pro Ile Asp Glu Lys Ile Lys Ala Lys  
 295 300 305  
  
 aag ggc agc gtg tgg gtg ttg agc ttt cac gac ggt gtg ttc acc ggc 1075  
 Lys Gly Ser Val Trp Val Leu Ser Phe His Asp Gly Val Phe Thr Gly  
 310 315 320 325  
  
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 330 335

cca 1131

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 <213> Corynebacterium glutamicum

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 Thr Glu Glu Phe Thr Arg Pro Thr Leu Ala Ala Gly Ala Val Leu Trp  
 35 40 45  
  
 Arg Gly Asp Ile Thr Asn Pro Asp Ser Ile Glu Val Ala Val Ile His  
 50 55 60

Arg Pro His Tyr Asp Asp Trp Ser Leu Ala Lys Gly Lys Val Asp Pro  
 65 70 75 80  
 Gly Glu Ser Ile Pro Thr Thr Ala Ala Arg Glu Ile Leu Glu Glu Thr  
 85 90 95  
 Gly Tyr Asp Ile Arg Leu Gly Lys Leu Ile Gly Lys Val Thr Tyr Pro  
 100 105 110  
 Val Leu Asp Arg Thr Lys Val Val Tyr Tyr Trp Thr Ala Gln Val Leu  
 115 120 125  
 Gly Gly Glu Phe Val Pro Asn Asp Glu Val Asp Glu Ile Arg Trp Leu  
 130 135 140  
 Ser Val Asp Glu Ala Cys Glu Leu Leu Ser Tyr Gln Val Asp Thr Glu  
 145 150 155 160  
 Val Leu Ala Lys Ala Ala Lys Arg Phe Arg Thr Pro Ser Thr Thr Arg  
 165 170 175  
 Val Leu Tyr Val Arg His Ala His Ala His Gly Arg Gln Thr Trp Gly  
 180 185 190  
 Gly Asp Asp Asn Lys Arg Pro Leu Asp Lys Lys Gly Arg Arg Gln Ala  
 195 200 205  
 Glu Met Leu Val Pro Met Leu Leu Pro Phe Lys Pro Thr Ala Ile Tyr  
 210 215 220  
 Ser Ala Val Pro Asp Arg Cys Gln Ala Thr Ala Leu Pro Leu Ala Asp  
 225 230 235 240  
 Glu Leu Gly Leu Asp Val Ser Val Asn Arg Leu Phe Gly Asp Asp Ala  
 245 250 255  
 Trp Glu Thr Asp Pro Glu Ala Cys Lys Lys Arg Phe Thr Asp Val Val  
 260 265 270  
 Ala Gln Gly Gly Val Pro Met Ile Val Gly Gln Gly Asp Ile Ile Pro  
 275 280 285  
 Glu Met Ile Lys Trp Phe Ser Glu Asn Gly Thr Leu Pro Ile Asp Glu  
 290 295 300  
 Lys Ile Lys Ala Lys Lys Gly Ser Val Trp Val Leu Ser Phe His Asp  
 305 310 315 320  
 Gly Val Phe Thr Gly Ala Asp Tyr Leu Ala Ser Ser Leu Pro Val Lys  
 325 330 335

&lt;210&gt; 103

<211> 651  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(628)  
 <223> RXS01528

<400> 103

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gggtcgtagg tctccaacca ggaggcgttc caacacgagg gtg aat cag gcg tgg 115
                               Val Asn Gln Ala Trp
                               1                               5

cag cag tcc cgt ttg gtt act tct gat gag act tcc gca ggt ggt ctc 163
Gln Gln Ser Arg Leu Val Thr Ser Asp Glu Thr Ser Ala Gly Gly Leu
                               10                               15                               20

gtg gtg tca ggt ttg gct gag gcg gtc aac gct aac aat gag gtt gat 211
Val Val Ser Gly Leu Ala Glu Ala Val Asn Ala Asn Asn Glu Val Asp
                               25                               30                               35

ctg tcg aag att tat gtt gcg ttg att ggt cgc ctt gat cgt cgt ggt 259
Leu Ser Lys Ile Tyr Val Ala Leu Ile Gly Arg Leu Asp Arg Arg Gly
                               40                               45                               50

cgt ttg ttg tgg tcg atg ccg aag ggc cat gtt gag cct ggt gag gat 307
Arg Leu Leu Trp Ser Met Pro Lys Gly His Val Glu Pro Gly Glu Asp
                               55                               60                               65

aag gct gcg act gct gag cgt gag gtg tgg gag gag acc ggc atc cac 355
Lys Ala Ala Thr Ala Glu Arg Glu Val Trp Glu Glu Thr Gly Ile His
                               70                               75                               80                               85

ggg gag gtg ttc act gag ttg ggt gtg att gat tat tgg ttc gtt tcg 403
Gly Glu Val Phe Thr Glu Leu Gly Val Ile Asp Tyr Trp Phe Val Ser
                               90                               95                               100

gaa ggg aag cgg atc cat aag acg gtg cat cat cat ttg ttg cgt tat 451
Glu Gly Lys Arg Ile His Lys Thr Val His His His Leu Leu Arg Tyr
                               105                               110                               115

gtt gat ggc gat ttg aat gat gag gat cca gaa gtc act gag gtg gcg 499
Val Asp Gly Asp Leu Asn Asp Glu Asp Pro Glu Val Thr Glu Val Ala
                               120                               125                               130

tgg att ccg gcg aat cag ttg att gag cat ttg gct ttt gcg gat gag 547
Trp Ile Pro Ala Asn Gln Leu Ile Glu His Leu Ala Phe Ala Asp Glu
                               135                               140                               145

cgg aag ttg gct agg cag gcg cat gat ttg ttg cct gag ttt gct ttg 595
Arg Lys Leu Ala Arg Gln Ala His Asp Leu Leu Pro Glu Phe Ala Leu
                               150                               155                               160                               165

aag gaa aag gcg gag gga agg tcc acc cca agg tgattccgaa ccccaaccg 648

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Lys Glu Lys Ala Glu Gly Arg Ser Thr Pro Arg  
 170 175

aac

651

<210> 104  
 <211> 176  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 104  
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 Ser Ala Gly Gly Leu Val Val Ser Gly Leu Ala Glu Ala Val Asn Ala  
 20 25 30  
 Asn Asn Glu Val Asp Leu Ser Lys Ile Tyr Val Ala Leu Ile Gly Arg  
 35 40 45  
 Leu Asp Arg Arg Gly Arg Leu Leu Trp Ser Met Pro Lys Gly His Val  
 50 55 60  
 Glu Pro Gly Glu Asp Lys Ala Ala Thr Ala Glu Arg Glu Val Trp Glu  
 65 70 75 80  
 Glu Thr Gly Ile His Gly Glu Val Phe Thr Glu Leu Gly Val Ile Asp  
 85 90 95  
 Tyr Trp Phe Val Ser Glu Gly Lys Arg Ile His Lys Thr Val His His  
 100 105 110  
 His Leu Leu Arg Tyr Val Asp Gly Asp Leu Asn Asp Glu Asp Pro Glu  
 115 120 125  
 Val Thr Glu Val Ala Trp Ile Pro Ala Asn Gln Leu Ile Glu His Leu  
 130 135 140  
 Ala Phe Ala Asp Glu Arg Lys Leu Ala Arg Gln Ala His Asp Leu Leu  
 145 150 155 160  
 Pro Glu Phe Ala Leu Lys Glu Lys Ala Glu Gly Arg Ser Thr Pro Arg  
 165 170 175

<210> 105  
 <211> 509  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (1)..(486)

&lt;223&gt; RXS01716

&lt;400&gt; 105

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Glu Val Thr Pro Glu Gly Phe Lys Glu Ile Thr Arg Glu Asn Thr Ile	
1 5 10 15	
gtt cgc ctg ggc aaa ggc gtc gac gcc acc ggt cag cta gac ccc gag	96
Val Arg Leu Gly Lys Gly Val Asp Ala Thr Gly Gln Leu Asp Pro Glu	
20 25 30	
gca atc gag cgc act cgt gtc gct ttg gaa aac tac gtt gaa ctc atg	144
Ala Ile Glu Arg Thr Arg Val Ala Leu Glu Asn Tyr Val Glu Leu Met	
35 40 45	
gaa acc cat ggg gta gag gcc gta cga atg gtt gcc acc tcc gca acc	192
Glu Thr His Gly Val Glu Ala Val Arg Met Val Ala Thr Ser Ala Thr	
50 55 60	
cgc gat gcg tcc aac cgc gat gaa ttc ttt tcg atg acc cgc cag ctt	240
Arg Asp Ala Ser Asn Arg Asp Glu Phe Phe Ser Met Thr Arg Gln Leu	
65 70 75 80	
ctg tcc aag atc cgt cct gga tac caa gct gaa gta att tcc ggc gaa	288
Leu Ser Lys Ile Arg Pro Gly Tyr Gln Ala Glu Val Ile Ser Gly Glu	
85 90 95	
gag gaa gct ctg ctg tcc ttc cga ggt gca atc gtt gac ctg cct gaa	336
Glu Glu Ala Leu Leu Ser Phe Arg Gly Ala Ile Val Asp Leu Pro Glu	
100 105 110	
gac caa ggt cct ttc tgt gtt atc gac ctt ggc ggt gga tcc act gag	384
Asp Gln Gly Pro Phe Cys Val Ile Asp Leu Gly Gly Gly Ser Thr Glu	
115 120 125	
ttc atc gtt ggc acc tac gac ggt gaa atc cta ggc tcc cac tca acc	432
Phe Ile Val Gly Thr Tyr Asp Gly Glu Ile Leu Gly Ser His Ser Thr	
130 135 140	
caa atg gga tgc gtg cgc ctg acc gaa cga atc atg cgc agc gac cca	480
Gln Met Gly Cys Val Arg Leu Thr Glu Arg Ile Met Arg Ser Asp Pro	
145 150 155 160	
ccc gac tgaaaccgaa gtggaaatcg ccc	509
Pro Asp	

&lt;210&gt; 106

&lt;211&gt; 162

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 106

Glu Val Thr Pro Glu Gly Phe Lys Glu Ile Thr Arg Glu Asn Thr Ile
1 5 10 15



Val Arg Leu Gly Lys Gly Val Asp Ala Thr Gly Gln Leu Asp Pro Glu  
 20 25 30

Ala Ile Glu Arg Thr Arg Val Ala Leu Glu Asn Tyr Val Glu Leu Met  
 35 40 45

Glu Thr His Gly Val Glu Ala Val Arg Met Val Ala Thr Ser Ala Thr  
 50 55 60

Arg Asp Ala Ser Asn Arg Asp Glu Phe Phe Ser Met Thr Arg Gln Leu  
 65 70 75 80

Leu Ser Lys Ile Arg Pro Gly Tyr Gln Ala Glu Val Ile Ser Gly Glu  
 85 90 95

Glu Glu Ala Leu Leu Ser Phe Arg Gly Ala Ile Val Asp Leu Pro Glu  
 100 105 110

Asp Gln Gly Pro Phe Cys Val Ile Asp Leu Gly Gly Gly Ser Thr Glu  
 115 120 125

Phe Ile Val Gly Thr Tyr Asp Gly Glu Ile Leu Gly Ser His Ser Thr  
 130 135 140

Gln Met Gly Cys Val Arg Leu Thr Glu Arg Ile Met Arg Ser Asp Pro  
 145 150 155 160

Pro Asp

<210> 107  
 <211> 654  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(631)  
 <223> RXS01835

<400> 107  
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ttcctgcgtg aatacacttt ccccgcgctt tcgcaaagct atg aat act gcc gcg 115  
 Met Asn Thr Ala Ala  
 1 5

tgg gca cac cgc cac cac gta cgc aaa ggc ggt gga att ccg tat gtc 163  
 Trp Ala His Arg His His Val Arg Lys Gly Gly Gly Ile Pro Tyr Val  
 10 15 20

agc cat ctt tat tca gtg atg tac ttg ctg gcc agc gtc act aat gat 211  
 Ser His Leu Tyr Ser Val Met Tyr Leu Leu Ala Ser Val Thr Asn Asp  
 25 30 35

gaa gat gtg ctc atc gcc ggg ctg ctc cac gac acc ctc gaa gac gta 259

Glu Asp Val Leu Ile Ala Gly Leu Leu His Asp Thr Leu Glu Asp Val  
 40 45 50  
 ccc gag gaa tac aat tct gcc caa ctt gaa gct gat ttt ggt ccg cgg 307  
 Pro Glu Glu Tyr Asn Ser Ala Gln Leu Glu Ala Asp Phe Gly Pro Arg  
 55 60 65  
 gtg cgc gag ttg gtg gaa gag ctc acc aaa cag ccc tta aaa agc tgg 355  
 Val Arg Glu Leu Val Glu Glu Leu Thr Lys Gln Pro Leu Lys Ser Trp  
 70 75 80 85  
 aaa gcg cgt gcc gac gct tac ctc ctg cac ctc agc gca ggt gcc agc 403  
 Lys Ala Arg Ala Asp Ala Tyr Leu Leu His Leu Ser Ala Gly Ala Ser  
 90 95 100  
 tta gag gct gtc tta atc tcc acc gca gat aaa ctg cat aat ctc atg 451  
 Leu Glu Ala Val Leu Ile Ser Thr Ala Asp Lys Leu His Asn Leu Met  
 105 110 115  
 tcc atc ttg gat gac ctt gaa ata cac ggt gaa gat tta tgg caa cgc 499  
 Ser Ile Leu Asp Asp Leu Glu Ile His Gly Glu Asp Leu Trp Gln Arg  
 120 125 130  
 ttt aac gct ggc aaa gag cag caa atc tgg tgg tat agc gag gtt tat 547  
 Phe Asn Ala Gly Lys Glu Gln Gln Ile Trp Trp Tyr Ser Glu Val Tyr  
 135 140 145  
 cag ata tct ctc cag cgc tta ggg ttc aat gag ttg aat aaa caa ctg 595  
 Gln Ile Ser Leu Gln Arg Leu Gly Phe Asn Glu Leu Asn Lys Gln Leu  
 150 155 160 165  
 ggg ttg tgc gtc gaa aag ctc tta aag caa agc gcc taggcgctcg 641  
 Gly Leu Cys Val Glu Lys Leu Leu Lys Gln Ser Ala  
 170 175  
 gcggcgctcga taa 654

<210> 108  
 <211> 177  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 108  
 Met Asn Thr Ala Ala Trp Ala His Arg His His Val Arg Lys Gly Gly  
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 Gly Ile Pro Tyr Val Ser His Leu Tyr Ser Val Met Tyr Leu Leu Ala  
 20 25 30  
 Ser Val Thr Asn Asp Glu Asp Val Leu Ile Ala Gly Leu Leu His Asp  
 35 40 45  
 Thr Leu Glu Asp Val Pro Glu Glu Tyr Asn Ser Ala Gln Leu Glu Ala  
 50 55 60  
 Asp Phe Gly Pro Arg Val Arg Glu Leu Val Glu Glu Leu Thr Lys Gln

65	70	75	80
Pro Leu Lys Ser Trp Lys Ala Arg Ala Asp Ala Tyr Leu Leu His Leu	85	90	95
Ser Ala Gly Ala Ser Leu Glu Ala Val Leu Ile Ser Thr Ala Asp Lys	100	105	110
Leu His Asn Leu Met Ser Ile Leu Asp Asp Leu Glu Ile His Gly Glu	115	120	125
Asp Leu Trp Gln Arg Phe Asn Ala Gly Lys Glu Gln Gln Ile Trp Trp	130	135	140
Tyr Ser Glu Val Tyr Gln Ile Ser Leu Gln Arg Leu Gly Phe Asn Glu	145	150	155
Leu Asn Lys Gln Leu Gly Leu Cys Val Glu Lys Leu Leu Lys Gln Ser	165	170	175

Ala

<210> 109  
 <211> 1050  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <223> RXS02497

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 gattcacact ttgccaccct agaccgtcta accttttaggt gtg aga tta ggt gta 115  
 Val Arg Leu Gly Val  
 1 5  
 tta gat gtg ggc agc aat act gtc cac cta gtt gca gta gac gcg cgt 163  
 Leu Asp Val Gly Ser Asn Thr Val His Leu Val Ala Val Asp Ala Arg  
 10 15 20  
 ccc ggt gga cac ccc acc ccg atg agc aat tgg cgt acc cca ctg cgc 211  
 Pro Gly Gly His Pro Thr Pro Met Ser Asn Trp Arg Thr Pro Leu Arg  
 25 30 35  
 ctt gtt gag ctt ctt gat gac tcc ggg gcg atc tcc gaa aag ggc atc 259  
 Leu Val Glu Leu Leu Asp Asp Ser Gly Ala Ile Ser Glu Lys Gly Ile  
 40 45 50  
 aac aaa ctc acc tca gca gtc ggg gaa gca gca gac cta gcg aaa acg 307  
 Asn Lys Leu Thr Ser Ala Val Gly Glu Ala Ala Asp Leu Ala Lys Thr  
 55 60 65

ctc ggc tgc gct gaa ctg atg cca ttt gct aca tcg gca gtc cgc tcc	355
Leu Gly Cys Ala Glu Leu Met Pro Phe Ala Thr Ser Ala Val Arg Ser	
70 75 80 85	
gcc acc aac agc gag gca gtg ctc gac cac gtg gag aag gaa acc ggc	403
Ala Thr Asn Ser Glu Ala Val Leu Asp His Val Glu Lys Glu Thr Gly	
90 95 100	
gtc cgc ctg tcc atc ctt tcc ggt gaa gac gaa gca cgc caa act ttc	451
Val Arg Leu Ser Ile Leu Ser Gly Glu Asp Glu Ala Arg Gln Thr Phe	
105 110 115	
ctc gca gtt cga cgt tgg tat gga tgg tcc gca ggg cgc ata act aac	499
Leu Ala Val Arg Arg Trp Tyr Gly Trp Ser Ala Gly Arg Ile Thr Asn	
120 125 130	
ctc gac atc ggt ggc ggc tcc ctg gaa cta tcc tcc gga acc gac gaa	547
Leu Asp Ile Gly Gly Gly Ser Leu Glu Leu Ser Ser Gly Thr Asp Glu	
135 140 145	
tcc cca gac ctc gcg ttc tca ctg gat ctg ggt gcg ggc cgc ttg acc	595
Ser Pro Asp Leu Ala Phe Ser Leu Asp Leu Gly Ala Gly Arg Leu Thr	
150 155 160 165	
cac aac tgg ttc gac acc gat cca ccg gca cgt aag aaa atc aac ctc	643
His Asn Trp Phe Asp Thr Asp Pro Pro Ala Arg Lys Lys Ile Asn Leu	
170 175 180	
ctg cgc gat tat atc gat gcg gaa ctt gca gaa ccc gcc cgc cag atg	691
Leu Arg Asp Tyr Ile Asp Ala Glu Leu Ala Glu Pro Ala Arg Gln Met	
185 190 195	
cgc acc cta ggg ccc gcg cgc ctg gca gtg gga aca tcc aaa act ttc	739
Arg Thr Leu Gly Pro Ala Arg Leu Ala Val Gly Thr Ser Lys Thr Phe	
200 205 210	
cgc acc ctg gca cga ctg act ggt gct gcg ccc tca tcc gca gga cca	787
Arg Thr Leu Ala Arg Leu Thr Gly Ala Ala Pro Ser Ser Ala Gly Pro	
215 220 225	
cac gtc acc cga acc ctc acc gcg ccg ggt ctg cgc cag ctg atc gca	835
His Val Thr Arg Thr Leu Thr Ala Pro Gly Leu Arg Gln Leu Ile Ala	
230 235 240 245	
ttt atc tca cga atg act gcg gcg gac cgc gct gag ctg gaa ggt atc	883
Phe Ile Ser Arg Met Thr Ala Ala Asp Arg Ala Glu Leu Glu Gly Ile	
250 255 260	
agc tcg gat cgg tca cat cag atc gtg gca ggt gcg cta gtt gcg gaa	931
Ser Ser Asp Arg Ser His Gln Ile Val Ala Gly Ala Leu Val Ala Glu	
265 270 275	
gct gcg atg cgt gcg ttg gat att gac aag gta gaa att tgt ccg tgg	979
Ala Ala Met Arg Ala Leu Asp Ile Asp Lys Val Glu Ile Cys Pro Trp	
280 285 290	
gca ctt cgt gaa ggt gtg atc ctc acc agg atc gac aaa gga ctc gag	1027

Ala Leu Arg Glu Gly Val Ile Leu Thr Arg Ile Asp Lys Gly Leu Glu  
 295 300 305

taacattttac ccggaaagga gtt

1050

<210> 110

<211> 309

<212> PRT

<213> Corynebacterium glutamicum

<400> 110

Val Arg Leu Gly Val Leu Asp Val Gly Ser Asn Thr Val His Leu Val  
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Ala Val Asp Ala Arg Pro Gly Gly His Pro Thr Pro Met Ser Asn Trp  
 20 25 30

Arg Thr Pro Leu Arg Leu Val Glu Leu Leu Asp Asp Ser Gly Ala Ile  
 35 40 45

Ser Glu Lys Gly Ile Asn Lys Leu Thr Ser Ala Val Gly Glu Ala Ala  
 50 55 60

Asp Leu Ala Lys Thr Leu Gly Cys Ala Glu Leu Met Pro Phe Ala Thr  
 65 70 75 80

Ser Ala Val Arg Ser Ala Thr Asn Ser Glu Ala Val Leu Asp His Val  
 85 90 95

Glu Lys Glu Thr Gly Val Arg Leu Ser Ile Leu Ser Gly Glu Asp Glu  
 100 105 110

Ala Arg Gln Thr Phe Leu Ala Val Arg Arg Trp Tyr Gly Trp Ser Ala  
 115 120 125

Gly Arg Ile Thr Asn Leu Asp Ile Gly Gly Gly Ser Leu Glu Leu Ser  
 130 135 140

Ser Gly Thr Asp Glu Ser Pro Asp Leu Ala Phe Ser Leu Asp Leu Gly  
 145 150 155 160

Ala Gly Arg Leu Thr His Asn Trp Phe Asp Thr Asp Pro Pro Ala Arg  
 165 170 175

Lys Lys Ile Asn Leu Leu Arg Asp Tyr Ile Asp Ala Glu Leu Ala Glu  
 180 185 190

Pro Ala Arg Gln Met Arg Thr Leu Gly Pro Ala Arg Leu Ala Val Gly  
 195 200 205

Thr Ser Lys Thr Phe Arg Thr Leu Ala Arg Leu Thr Gly Ala Ala Pro  
 210 215 220

Ser Ser Ala Gly Pro His Val Thr Arg Thr Leu Thr Ala Pro Gly Leu  
 225 230 235 240

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<210> 111
<211> 534
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
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<222> (101)..(511)  
<223> RXS02972
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						Val	Glu	Ile	Ala	Arg							
						1				5							
gac	tac	gtt	gca	gaa	cgc	atc	cag	gaa	gta	aaa	gcc	atc	gtc	cca	att	163	
Asp	Tyr	Val	Ala	Glu	Arg	Ile	Gln	Glu	Val	Lys	Ala	Ile	Val	Pro	Ile		
				10					15					20			
tca	aag	gca	aaa	acc	ttt	gtg	gga	tgc	gca	ggc	acc	ttc	acc	aca	atc	211	
Ser	Lys	Ala	Lys	Thr	Phe	Val	Gly	Cys	Ala	Gly	Thr	Phe	Thr	Thr	Ile		
			25					30					35				
tcc	gcc	tgg	gtg	caa	ggc	cta	gaa	agc	tac	gac	cgc	gac	gcg	atc	cac	259	
Ser	Ala	Trp	Val	Gln	Gly	Leu	Glu	Ser	Tyr	Asp	Arg	Asp	Ala	Ile	His		
			40					45					50				
ctc	tct	gca	ctc	aac	ttc	gat	gca	ctg	cga	gtt	gtc	acc	gat	gag	atc	307	
Leu	Ser	Ala	Leu	Asn	Phe	Asp	Ala	Leu	Arg	Val	Val	Thr	Asp	Glu	Ile		
			55					60					65				
att	tca	gaa	tca	tca	tca	cag	cgc	gcc	agc	aac	cca	gtt	gtt	gat	cca	355	
Ile	Ser	Glu	Ser	Ser	Ser	Gln	Arg	Ala	Ser	Asn	Pro	Val	Val	Asp	Pro		
70					75					80					85		
ggt	cgc	gcc	gac	gtc	atc	ggt	ggc	gga	tcc	gtt	gtt	gtc	caa	gca	gcg	403	
Gly	Arg	Ala	Asp	Val	Ile	Gly	Gly	Gly	Ser	Val	Val	Val	Gln	Ala	Ala		
				90					95					100			



atc gac tta gcc tcc aaa gaa gcc ggt gta gac tac atc att att tcc 451  
 Ile Asp Leu Ala Ser Lys Glu Ala Gly Val Asp Tyr Ile Ile Ile Ser  
           105                          110                          115

gaa aaa gac atc ctc gac ggc ctc atc ctt ggc ctg gta gaa gcc gac 499  
 Glu Lys Asp Ile Leu Asp Gly Leu Ile Leu Gly Leu Val Glu Ala Asp  
           120                          125                          130

tct ttg aag aaa taggacccta gttttaaacc act 534  
 Ser Leu Lys Lys  
           135

<210> 112  
 <211> 137  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 112  
 Val Glu Ile Ala Arg Asp Tyr Val Ala Glu Arg Ile Gln Glu Val Lys  
       1                          5                          10                          15

Ala Ile Val Pro Ile Ser Lys Ala Lys Thr Phe Val Gly Cys Ala Gly  
           20                          25                          30

Thr Phe Thr Thr Ile Ser Ala Trp Val Gln Gly Leu Glu Ser Tyr Asp  
           35                          40                          45

Arg Asp Ala Ile His Leu Ser Ala Leu Asn Phe Asp Ala Leu Arg Val  
           50                          55                          60

Val Thr Asp Glu Ile Ile Ser Glu Ser Ser Ser Gln Arg Ala Ser Asn  
       65                          70                          75                          80

Pro Val Val Asp Pro Gly Arg Ala Asp Val Ile Gly Gly Gly Ser Val  
           85                          90                          95

Val Val Gln Ala Ala Ile Asp Leu Ala Ser Lys Glu Ala Gly Val Asp  
           100                          105                          110

Tyr Ile Ile Ile Ser Glu Lys Asp Ile Leu Asp Gly Leu Ile Leu Gly  
           115                          120                          125

Leu Val Glu Ala Asp Ser Leu Lys Lys  
       130                          135

<210> 113  
 <211> 636  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(613)  
 <223> RXA02159

&lt;400&gt; 113

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actgctggtg tggctgctgg ccaaccagcc gaggtaagac atg tcc ctt ggc tca 115  
 Met Ser Leu Gly Ser  
 1 5

acc ccg tca aca ccg gaa aac tta aat ccc gtg act cgc act gca cgc 163  
 Thr Pro Ser Thr Pro Glu Asn Leu Asn Pro Val Thr Arg Thr Ala Arg  
 10 15 20

caa gct ctc att ttg cag att ttg gac aaa caa aaa gtc acc agc cag 211  
 Gln Ala Leu Ile Leu Gln Ile Leu Asp Lys Gln Lys Val Thr Ser Gln  
 25 30 35

gta caa ctg tct gaa ttg ctg ctg gat gaa ggc atc gat atc acc cag 259  
 Val Gln Leu Ser Glu Leu Leu Leu Asp Glu Gly Ile Asp Ile Thr Gln  
 40 45 50

gcc acc ttg tcc cga gat ctc gat gaa ctc ggt gca cgc aag gtt cgc 307  
 Ala Thr Leu Ser Arg Asp Leu Asp Glu Leu Gly Ala Arg Lys Val Arg  
 55 60 65

ccc gat ggg gga cgc gcc tac tac gcg gtc ggc cca gta gat agc atc 355  
 Pro Asp Gly Gly Arg Ala Tyr Tyr Ala Val Gly Pro Val Asp Ser Ile  
 70 75 80 85

gcc cgc gaa gat ctc cgg ggt ccg tcg gag aag ctg cgc cgc atg ctt 403  
 Ala Arg Glu Asp Leu Arg Gly Pro Ser Glu Lys Leu Arg Arg Met Leu  
 90 95 100

gat gaa ctg ctg gtt tct aca gat cat tcc ggc aac atc gcg atg ctg 451  
 Asp Glu Leu Leu Val Ser Thr Asp His Ser Gly Asn Ile Ala Met Leu  
 105 110 115

cgc acc ccg ccg gga gct gcc cag tac ctg gca agt ttc atc gat agg 499  
 Arg Thr Pro Pro Gly Ala Ala Gln Tyr Leu Ala Ser Phe Ile Asp Arg  
 120 125 130

gtg ggg ctg aaa gaa gtc gtt ggc acc atc gct ggt gat gac acc gtt 547  
 Val Gly Leu Lys Glu Val Val Gly Thr Ile Ala Gly Asp Asp Thr Val  
 135 140 145

ttc gtt ctc gcc cgt gat ccg ctc aca ggt aaa gaa cta ggt gaa tta 595  
 Phe Val Leu Ala Arg Asp Pro Leu Thr Gly Lys Glu Leu Gly Glu Leu  
 150 155 160 165

ctc agc ggg cgc acc act taaagcgccc ctagttcaag gct 636  
 Leu Ser Gly Arg Thr Thr  
 170

&lt;210&gt; 114

&lt;211&gt; 171

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 114

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Met Ser Leu Gly Ser Thr Pro Ser Thr Pro Glu Asn Leu Asn Pro Val
 1              5              10              15

Thr Arg Thr Ala Arg Gln Ala Leu Ile Leu Gln Ile Leu Asp Lys Gln
      20              25              30

Lys Val Thr Ser Gln Val Gln Leu Ser Glu Leu Leu Leu Asp Glu Gly
      35              40              45

Ile Asp Ile Thr Gln Ala Thr Leu Ser Arg Asp Leu Asp Glu Leu Gly
      50              55              60

Ala Arg Lys Val Arg Pro Asp Gly Gly Arg Ala Tyr Tyr Ala Val Gly
      65              70              75              80

Pro Val Asp Ser Ile Ala Arg Glu Asp Leu Arg Gly Pro Ser Glu Lys
      85              90              95

Leu Arg Arg Met Leu Asp Glu Leu Leu Val Ser Thr Asp His Ser Gly
      100             105             110

Asn Ile Ala Met Leu Arg Thr Pro Pro Gly Ala Ala Gln Tyr Leu Ala
      115             120             125

Ser Phe Ile Asp Arg Val Gly Leu Lys Glu Val Val Gly Thr Ile Ala
      130             135             140

Gly Asp Asp Thr Val Phe Val Leu Ala Arg Asp Pro Leu Thr Gly Lys
      145             150             155             160

Glu Leu Gly Glu Leu Leu Ser Gly Arg Thr Thr
      165             170

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&lt;210&gt; 115

&lt;211&gt; 486

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(463)

&lt;223&gt; RXA02201

&lt;400&gt; 115

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agtacttttc gtttgcgtcg gcaatggtgg aaaatctcaa atg gcc gca gcg cta 115
                               Met Ala Ala Ala Leu
                               1              5

gcc aaa aaa cat gcc ggg gac gct ctc aaa gtt tat tca gct ggc aca 163
Ala Lys Lys His Ala Gly Asp Ala Leu Lys Val Tyr Ser Ala Gly Thr
      10              15              20

aag cca ggt acg aaa tta aat caa cag tcc ctt gat tcc att gct gaa 211

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Lys Pro Gly Thr Lys Leu Asn Gln Gln Ser Leu Asp Ser Ile Ala Glu  
                   25                                  30                                  35  
 gtt ggc gca gat atg tct caa ggg ttt cca aag ggc att gac cag gag 259  
 Val Gly Ala Asp Met Ser Gln Gly Phe Pro Lys Gly Ile Asp Gln Glu  
                   40                                  45                                  50  
 tta att aag cga gta gac cgc gtg gtc att ctt ggt gcc gaa gct caa 307  
 Leu Ile Lys Arg Val Asp Arg Val Val Ile Leu Gly Ala Glu Ala Gln  
                   55                                  60                                  65  
 cta gaa atg cct atc gat gca aac ggc ata cta cag cgc tgg gta act 355  
 Leu Glu Met Pro Ile Asp Ala Asn Gly Ile Leu Gln Arg Trp Val Thr  
                   70                                  75                                  80                                  85  
 gac gaa ccc tct gaa cgt gga att gaa ggt atg gaa cgc atg cgc ctg 403  
 Asp Glu Pro Ser Glu Arg Gly Ile Glu Gly Met Glu Arg Met Arg Leu  
                                   90                                  95                                  100  
 gtc cga gat gat att gac gcc cga gtc caa aac ctc gtc gct gaa cta 451  
 Val Arg Asp Asp Ile Asp Ala Arg Val Gln Asn Leu Val Ala Glu Leu  
                                   105                                  110                                  115  
 acc caa aac gca tagcagtttt ctaatctcac aca 486  
 Thr Gln Asn Ala  
                   120

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 <213> Corynebacterium glutamicum

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 Tyr Ser Ala Gly Thr Lys Pro Gly Thr Lys Leu Asn Gln Gln Ser Leu  
                   20                                  25                                  30  
 Asp Ser Ile Ala Glu Val Gly Ala Asp Met Ser Gln Gly Phe Pro Lys  
                   35                                  40                                  45  
 Gly Ile Asp Gln Glu Leu Ile Lys Arg Val Asp Arg Val Val Ile Leu  
                   50                                  55                                  60  
 Gly Ala Glu Ala Gln Leu Glu Met Pro Ile Asp Ala Asn Gly Ile Leu  
                   65                                  70                                  75                                  80  
 Gln Arg Trp Val Thr Asp Glu Pro Ser Glu Arg Gly Ile Glu Gly Met  
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 Glu Arg Met Arg Leu Val Arg Asp Asp Ile Asp Ala Arg Val Gln Asn  
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 Leu Val Ala Glu Leu Thr Gln Asn Ala  
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&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 118

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 20 25 30

His Ser Ala Gly Thr Lys Pro Ala Gln Gly Leu Asn Gln Leu Ser Val  
 35 40 45

Glu Ser Ile Ala Glu Val Gly Ala Asp Met Ser Gln Gly Ile Pro Lys  
 50 55 60

Ala Ile Asp Pro Glu Leu Leu Arg Thr Val Asp Arg Val Val Ile Leu  
 65 70 75 80

Gly Asp Asp Ala Gln Val Asp Met Pro Glu Ser Ala Gln Gly Ala Leu  
 85 90 95

Glu Arg Trp Ser Ile Glu Glu Pro Asp Ala Gln Gly Met Glu Arg Met  
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Arg Ile Val Arg Asp Gln Ile Asp Asn Arg Val Gln Ala Leu Leu Ala  
 115 120 125

Gly

&lt;210&gt; 119

&lt;211&gt; 1221

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(1198)

&lt;223&gt; RXA00600

&lt;400&gt; 119

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 catcgatatt gaaggatatt ttatatcggc aaacatcaat atg att gaa ggc tgg 115  
 Met Ile Glu Gly Trp  
 1 5  
 ctc atg acc ctt act aaa gag cat tcg aca cct cga gcg gct ggc tca 163  
 Leu Met Thr Leu Thr Lys Glu His Ser Thr Pro Arg Ala Ala Gly Ser  
 10 15 20  
 atg tcg ttt ctt gac cgc tgg tta gct gcc tgg att ttc ttg gct atg 211  
 Met Ser Phe Leu Asp Arg Trp Leu Ala Ala Trp Ile Phe Leu Ala Met  
 25 30 35  
 gct gct ggg ttg tta atc ggc aag gtc ttt cca gga att ggg gcg ctt 259



Ala	Ala	Gly	Leu	Leu	Ile	Gly	Lys	Val	Phe	Pro	Gly	Ile	Gly	Ala	Leu		
		40					45					50					
ttg	agc	gcg	gtg	gaa	att	ggg	gga	att	tcc	att	cca	att	gct	atc	ggg	307	
Leu	Ser	Ala	Val	Glu	Ile	Gly	Gly	Ile	Ser	Ile	Pro	Ile	Ala	Ile	Gly		
	55					60					65						
ttg	atc	gtc	atg	atg	tat	cca	cct	ttg	gcc	aag	gtg	cgc	tac	gac	aaa	355	
Leu	Ile	Val	Met	Met	Tyr	Pro	Pro	Leu	Ala	Lys	Val	Arg	Tyr	Asp	Lys		
	70				75					80					85		
act	aaa	gaa	atc	agc	aca	gac	cgc	gct	ctc	atg	gtg	gtg	tcg	att	atg	403	
Thr	Lys	Glu	Ile	Ser	Thr	Asp	Arg	Ala	Leu	Met	Val	Val	Ser	Ile	Met		
				90					95					100			
ttg	aac	tgg	atc	gtt	gga	cca	gca	ctt	atg	ttt	agc	ctg	gcg	tgg	ctg	451	
Leu	Asn	Trp	Ile	Val	Gly	Pro	Ala	Leu	Met	Phe	Ser	Leu	Ala	Trp	Leu		
			105					110						115			
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Phe	Leu	Pro	Asp	Gln	Pro	Glu	Leu	Arg	Thr	Gly	Leu	Ile	Ile	Val	Gly		
		120						125				130					
ctt	gcg	cgc	tgt	atc	gcg	atg	gtt	ttg	gta	tgg	agt	gat	ctc	gct	tgt	547	
Leu	Ala	Arg	Cys	Ile	Ala	Met	Val	Leu	Val	Trp	Ser	Asp	Leu	Ala	Cys		
	135					140					145						
ggg	gac	cgg	gaa	gca	act	gct	gtg	ctg	gtt	gca	atc	aac	tcg	gtg	ttc	595	
Gly	Asp	Arg	Glu	Ala	Thr	Ala	Val	Leu	Val	Ala	Ile	Asn	Ser	Val	Phe		
	150				155					160					165		
cag	atc	ctt	atg	ttc	ggg	gtg	ctt	ggg	tgg	ttt	tac	ctg	cag	att	ctt	643	
Gln	Ile	Leu	Met	Phe	Gly	Val	Leu	Gly	Trp	Phe	Tyr	Leu	Gln	Ile	Leu		
			170						175					180			
ccc	tcg	tgg	ctg	gga	tta	gac	acc	acg	tcg	gtg	act	ttc	tct	gtg	gta	691	
Pro	Ser	Trp	Leu	Gly	Leu	Asp	Thr	Thr	Ser	Val	Thr	Phe	Ser	Val	Val		
			185					190					195				
tca	atc	gtg	act	tcc	gtt	ctc	gtg	ttc	ttg	ggc	ata	cca	ctt	gta	gct	739	
Ser	Ile	Val	Thr	Ser	Val	Leu	Val	Phe	Leu	Gly	Ile	Pro	Leu	Val	Ala		
		200					205					210					
gga	gtt	tta	tct	cgc	gtc	att	ggg	gaa	aaa	aca	aag	gga	cgg	cgc	tgg	787	
Gly	Val	Leu	Ser	Arg	Val	Ile	Gly	Glu	Lys	Thr	Lys	Gly	Arg	Arg	Trp		
	215					220					225						
tac	gag	gac	acg	ttc	ctg	cct	aag	att	tca	ccc	ttg	gcg	ctg	att	ggc	835	
Tyr	Glu	Asp	Thr	Phe	Leu	Pro	Lys	Ile	Ser	Pro	Leu	Ala	Leu	Ile	Gly		
	230				235					240					245		
ttg	cta	tac	aca	att	gtt	ctg	ctg	ttt	tcg	ttg	cag	ggg	gat	gaa	atc	883	
Leu	Leu	Tyr	Thr	Ile	Val	Leu	Leu	Phe	Ser	Leu	Gln	Gly	Asp	Glu	Ile		
				250				255						260			
aca	gcg	cag	cct	tgg	aca	gta	gct	cgt	ctt	gca	ttg	ccg	ctg	ctg	atg	931	
Thr	Ala	Gln	Pro	Trp	Thr	Val	Ala	Arg	Leu	Ala	Leu	Pro	Leu	Leu	Met		

265	270	275	
tac ttt gtg ggc atg ttt ttc att tcc ctg gtg gta tcc aaa ctg tcc			979
Tyr Phe Val Gly Met Phe Phe Ile Ser Leu Val Val Ser Lys Leu Ser			
280	285	290	
ggg tta act tat gag cga gct gct tcc gtg tct ttt act gca gca gga			1027
Gly Leu Thr Tyr Glu Arg Ala Ala Ser Val Ser Phe Thr Ala Ala Gly			
295	300	305	
aac aac ttt gaa tta gcg att gcg gta tcg atc gga acc ttt ggt gcg			1075
Asn Asn Phe Glu Leu Ala Ile Ala Val Ser Ile Gly Thr Phe Gly Ala			
310	315	320	325
aca tca ccg cag gca tta gct gga acg atc ggc cct ttg att gaa gtc			1123
Thr Ser Pro Gln Ala Leu Ala Gly Thr Ile Gly Pro Leu Ile Glu Val			
330	335	340	
cca gta tta gtc gga ttg gtt tat gtc atg ttg tgg ctt gga cca aaa			1171
Pro Val Leu Val Gly Leu Val Tyr Val Met Leu Trp Leu Gly Pro Lys			
345	350	355	
atc ttt aaa aag gag aat gca gga tca tgaaatcagt tttgtttgtg			1218
Ile Phe Lys Lys Glu Asn Ala Gly Ser			
360	365		

tgc 1221

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<211> 366

<212> PRT

<213> Corynebacterium glutamicum

<400> 120

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20 25 30

Ile Phe Leu Ala Met Ala Ala Gly Leu Leu Ile Gly Lys Val Phe Pro  
35 40 45

Gly Ile Gly Ala Leu Leu Ser Ala Val Glu Ile Gly Gly Ile Ser Ile  
50 55 60

Pro Ile Ala Ile Gly Leu Ile Val Met Met Tyr Pro Pro Leu Ala Lys  
65 70 75 80

Val Arg Tyr Asp Lys Thr Lys Glu Ile Ser Thr Asp Arg Ala Leu Met  
85 90 95

Val Val Ser Ile Met Leu Asn Trp Ile Val Gly Pro Ala Leu Met Phe  
100 105 110

Ser Leu Ala Trp Leu Phe Leu Pro Asp Gln Pro Glu Leu Arg Thr Gly

115					120					125					
Leu	Ile	Ile	Val	Gly	Leu	Ala	Arg	Cys	Ile	Ala	Met	Val	Leu	Val	Trp
130					135					140					
Ser	Asp	Leu	Ala	Cys	Gly	Asp	Arg	Glu	Ala	Thr	Ala	Val	Leu	Val	Ala
145					150					155					160
Ile	Asn	Ser	Val	Phe	Gln	Ile	Leu	Met	Phe	Gly	Val	Leu	Gly	Trp	Phe
				165					170					175	
Tyr	Leu	Gln	Ile	Leu	Pro	Ser	Trp	Leu	Gly	Leu	Asp	Thr	Thr	Ser	Val
			180					185					190		
Thr	Phe	Ser	Val	Val	Ser	Ile	Val	Thr	Ser	Val	Leu	Val	Phe	Leu	Gly
		195					200					205			
Ile	Pro	Leu	Val	Ala	Gly	Val	Leu	Ser	Arg	Val	Ile	Gly	Glu	Lys	Thr
	210					215					220				
Lys	Gly	Arg	Arg	Trp	Tyr	Glu	Asp	Thr	Phe	Leu	Pro	Lys	Ile	Ser	Pro
225					230					235					240
Leu	Ala	Leu	Ile	Gly	Leu	Leu	Tyr	Thr	Ile	Val	Leu	Leu	Phe	Ser	Leu
				245					250					255	
Gln	Gly	Asp	Glu	Ile	Thr	Ala	Gln	Pro	Trp	Thr	Val	Ala	Arg	Leu	Ala
			260					265					270		
Leu	Pro	Leu	Leu	Met	Tyr	Phe	Val	Gly	Met	Phe	Phe	Ile	Ser	Leu	Val
				275				280					285		
Val	Ser	Lys	Leu	Ser	Gly	Leu	Thr	Tyr	Glu	Arg	Ala	Ala	Ser	Val	Ser
				290				295					300		
Phe	Thr	Ala	Ala	Gly	Asn	Asn	Phe	Glu	Leu	Ala	Ile	Ala	Val	Ser	Ile
305					310					315					320
Gly	Thr	Phe	Gly	Ala	Thr	Ser	Pro	Gln	Ala	Leu	Ala	Gly	Thr	Ile	Gly
				325					330					335	
Pro	Leu	Ile	Glu	Val	Pro	Val	Leu	Val	Gly	Leu	Val	Tyr	Val	Met	Leu
				340					345				350		
Trp	Leu	Gly	Pro	Lys	Ile	Phe	Lys	Lys	Glu	Asn	Ala	Gly	Ser		
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 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1210)  
 <223> RXA02200

&lt;400&gt; 121

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tttgaatatc gacaggtatc aatataccga aaggtgtcgc atg aca aac tca act 115
                                   Met Thr Asn Ser Thr
                                   1                               5

cag acg cgg gcc aag cca gcc cga atc tca ttt ctt gat aaa tac att 163
Gln Thr Arg Ala Lys Pro Ala Arg Ile Ser Phe Leu Asp Lys Tyr Ile
                        10                               15                               20

cca ctt tgg att att ttg gcg atg gcg ttt ggg cta ttt tta ggc cgg 211
Pro Leu Trp Ile Ile Leu Ala Met Ala Phe Gly Leu Phe Leu Gly Arg
                        25                               30                               35

agc gtt tcg gga ctc tca ggc ttt cta ggc gca atg gaa gtc gga ggg 259
Ser Val Ser Gly Leu Ser Gly Phe Leu Gly Ala Met Glu Val Gly Gly
                        40                               45                               50

atc tcc ttg cca atc gct tta ggc ctc ctt gta atg atg tac cca ccg 307
Ile Ser Leu Pro Ile Ala Leu Gly Leu Leu Val Met Met Tyr Pro Pro
                        55                               60                               65

ttg gcc aaa gtt cgg tat gac aaa act aaa caa att gcc act gat aag 355
Leu Ala Lys Val Arg Tyr Asp Lys Thr Lys Gln Ile Ala Thr Asp Lys
70                               75                               80                               85

cat ttg atg ggc gtg tca ctc att ctc aat tgg gtg gtg ggt cct gcc 403
His Leu Met Gly Val Ser Leu Ile Leu Asn Trp Val Val Gly Pro Ala
                        90                               95                               100

tta atg ttc gcg cta gct tgg ttg ttc ctc cca gac caa ccg gaa tta 451
Leu Met Phe Ala Leu Ala Trp Leu Phe Leu Pro Asp Gln Pro Glu Leu
                        105                               110                               115

cga acc ggc ctg att att gta gga ctc gca cga tgt att gcg atg gtc 499
Arg Thr Gly Leu Ile Ile Val Gly Leu Ala Arg Cys Ile Ala Met Val
                        120                               125                               130

ttg gtt tgg tct gat atg tcc tgt gga gac cgc gag gct aca gca gtt 547
Leu Val Trp Ser Asp Met Ser Cys Gly Asp Arg Glu Ala Thr Ala Val
                        135                               140                               145

ctc gta gcc att aat tca gtt ttt caa gtc gca atg ttt ggt gca ctt 595
Leu Val Ala Ile Asn Ser Val Phe Gln Val Ala Met Phe Gly Ala Leu
150                               155                               160                               165

ggc tgg ttc tat ctg caa gtt tta cca tcc tgg cta gga tta cca act 643
Gly Trp Phe Tyr Leu Gln Val Leu Pro Ser Trp Leu Gly Leu Pro Thr
                        170                               175                               180

acc acc gct caa ttc tct ttc tgg tca att gtg act tcg gtt ttg gtg 691
Thr Thr Ala Gln Phe Ser Phe Trp Ser Ile Val Thr Ser Val Leu Val
                        185                               190                               195

ttc ctc gga ata cct cta ctt gct gga gtt ttc tcg cga att att ggc 739

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Phe Leu Gly Ile Pro Leu Leu Ala Gly Val Phe Ser Arg Ile Ile Gly  
 200 205 210  
 gaa aag atc aag gga cgt gag tgg tat gaa caa aag ttc ctt ccg gca 787  
 Glu Lys Ile Lys Gly Arg Glu Trp Tyr Glu Gln Lys Phe Leu Pro Ala  
 215 220 225  
 atc tct cca ttt gca cta atc ggt ctg ctt tat acg atc gtc ttg ttg 835  
 Ile Ser Pro Phe Ala Leu Ile Gly Leu Leu Tyr Thr Ile Val Leu Leu  
 230 235 240 245  
 ttt tca ttg caa ggt gat cag atc gtc tct caa cca tgg gct gta gtt 883  
 Phe Ser Leu Gln Gly Asp Gln Ile Val Ser Gln Pro Trp Ala Val Val  
 250 255 260  
 cgt ctc gcg ata cca ttg gtt atc tat ttc gtt gga atg ttt ttc att 931  
 Arg Leu Ala Ile Pro Leu Val Ile Tyr Phe Val Gly Met Phe Phe Ile  
 265 270 275  
 tca ctc att gcg tca aaa cta tct ggc atg aac tat gca aag tct gca 979  
 Ser Leu Ile Ala Ser Lys Leu Ser Gly Met Asn Tyr Ala Lys Ser Ala  
 280 285 290  
 tcc gtc tct ttc act gca gct ggc aac aat ttt gaa ctt gcg att gcg 1027  
 Ser Val Ser Phe Thr Ala Ala Gly Asn Asn Phe Glu Leu Ala Ile Ala  
 295 300 305  
 gtg tcg atc gga acg ttt ggc gca act tct gca cag gct atg gca gga 1075  
 Val Ser Ile Gly Thr Phe Gly Ala Thr Ser Ala Gln Ala Met Ala Gly  
 310 315 320 325  
 acg att ggt ccc ttg att gaa att cca gta ctt gtc ggc ttg gtc tac 1123  
 Thr Ile Gly Pro Leu Ile Glu Ile Pro Val Leu Val Gly Leu Val Tyr  
 330 335 340  
 gcc atg ctg tgg cta ggc ccc aag ttg ttc cca aat gac ccc acg ctg 1171  
 Ala Met Leu Trp Leu Gly Pro Lys Leu Phe Pro Asn Asp Pro Thr Leu  
 345 350 355  
 cca tca tca gct cgt tct acc agc caa atc atc aac tca tagcgaagga 1220  
 Pro Ser Ser Ala Arg Ser Thr Ser Gln Ile Ile Asn Ser  
 360 365 370  
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Leu Phe Leu Gly Arg Ser Val Ser Gly Leu Ser Gly Phe Leu Gly Ala  
 35 40 45  
 Met Glu Val Gly Gly Ile Ser Leu Pro Ile Ala Leu Gly Leu Leu Val  
 50 55 60  
 Met Met Tyr Pro Pro Leu Ala Lys Val Arg Tyr Asp Lys Thr Lys Gln  
 65 70 75 80  
 Ile Ala Thr Asp Lys His Leu Met Gly Val Ser Leu Ile Leu Asn Trp  
 85 90 95  
 Val Val Gly Pro Ala Leu Met Phe Ala Leu Ala Trp Leu Phe Leu Pro  
 100 105 110  
 Asp Gln Pro Glu Leu Arg Thr Gly Leu Ile Ile Val Gly Leu Ala Arg  
 115 120 125  
 Cys Ile Ala Met Val Leu Val Trp Ser Asp Met Ser Cys Gly Asp Arg  
 130 135 140  
 Glu Ala Thr Ala Val Leu Val Ala Ile Asn Ser Val Phe Gln Val Ala  
 145 150 155 160  
 Met Phe Gly Ala Leu Gly Trp Phe Tyr Leu Gln Val Leu Pro Ser Trp  
 165 170 175  
 Leu Gly Leu Pro Thr Thr Thr Ala Gln Phe Ser Phe Trp Ser Ile Val  
 180 185 190  
 Thr Ser Val Leu Val Phe Leu Gly Ile Pro Leu Leu Ala Gly Val Phe  
 195 200 205  
 Ser Arg Ile Ile Gly Glu Lys Ile Lys Gly Arg Glu Trp Tyr Glu Gln  
 210 215 220  
 Lys Phe Leu Pro Ala Ile Ser Pro Phe Ala Leu Ile Gly Leu Leu Tyr  
 225 230 235 240  
 Thr Ile Val Leu Leu Phe Ser Leu Gln Gly Asp Gln Ile Val Ser Gln  
 245 250 255  
 Pro Trp Ala Val Val Arg Leu Ala Ile Pro Leu Val Ile Tyr Phe Val  
 260 265 270  
 Gly Met Phe Phe Ile Ser Leu Ile Ala Ser Lys Leu Ser Gly Met Asn  
 275 280 285  
 Tyr Ala Lys Ser Ala Ser Val Ser Phe Thr Ala Ala Gly Asn Asn Phe  
 290 295 300  
 Glu Leu Ala Ile Ala Val Ser Ile Gly Thr Phe Gly Ala Thr Ser Ala  
 305 310 315 320  
 Gln Ala Met Ala Gly Thr Ile Gly Pro Leu Ile Glu Ile Pro Val Leu  
 325 330 335



Val Gly Leu Val Tyr Ala Met Leu Trp Leu Gly Pro Lys Leu Phe Pro  
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Asn Asp Pro Thr Leu Pro Ser Ser Ala Arg Ser Thr Ser Gln Ile Ile  
 355 360 365

Asn Ser  
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<210> 123

<211> 762

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(739)

<223> RXA02202

<400> 123

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 Met Thr Gly Gln Ala  
 1 5

gca cca aac ttg cat acc aat att ttg aac cgt atc gca aat gaa ctg 163  
 Ala Pro Asn Leu His Thr Asn Ile Leu Asn Arg Ile Ala Asn Glu Leu  
 10 15 20

gcg ttg acc tat caa gga gtt ttc tct gca gag act atc aac cgc tat 211  
 Ala Leu Thr Tyr Gln Gly Val Phe Ser Ala Glu Thr Ile Asn Arg Tyr  
 25 30 35

att ttt gaa tcg tat gtg tcg ttg gcg aga aca gca aaa atc cat acg 259  
 Ile Phe Glu Ser Tyr Val Ser Leu Ala Arg Thr Ala Lys Ile His Thr  
 40 45 50

cac ctg cca att ttg gca gaa ggt ttt gct aaa gac cgg ctg cac gca 307  
 His Leu Pro Ile Leu Ala Glu Gly Phe Ala Lys Asp Arg Leu His Ala  
 55 60 65

ctt gcg gta gct gaa ggt aag gtg gct tca cct gtg cct cag gtc cta 355  
 Leu Ala Val Ala Glu Gly Lys Val Ala Ser Pro Val Pro Gln Val Leu  
 70 75 80 85

ttt att tgc gtc cac aac gca ggt cgt tca caa att gct tcg gcg ttg 403  
 Phe Ile Cys Val His Asn Ala Gly Arg Ser Gln Ile Ala Ser Ala Leu  
 90 95 100

ttg tct cac tat gcc ggt agt tct gta gag gta cgt tct gca ggt tct 451  
 Leu Ser His Tyr Ala Gly Ser Ser Val Glu Val Arg Ser Ala Gly Ser  
 105 110 115

tta cct gct tct gaa att cac cca ctg gtg ttg gaa att ttg tca gag 499

Leu Pro Ala Ser Glu Ile His Pro Leu Val Leu Glu Ile Leu Ser Glu  
 120 125 130  
 cga gga gtg aac att tct gat gca ttt ccg aaa ccg cta acc gat gat 547  
 Arg Gly Val Asn Ile Ser Asp Ala Phe Pro Lys Pro Leu Thr Asp Asp  
 135 140 145  
 gtt att cgc gca tct gac tat gtc ata aca atg gga tgt gga gat gtg 595  
 Val Ile Arg Ala Ser Asp Tyr Val Ile Thr Met Gly Cys Gly Asp Val  
 150 155 160 165  
 tgc cca atg tat cca gga aag cac tat ctc gat tgg gag ctc gct gat 643  
 Cys Pro Met Tyr Pro Gly Lys His Tyr Leu Asp Trp Glu Leu Ala Asp  
 170 175 180  
 ccg tca gat gaa ggt gag gac aag ata cag gaa ata att gag gaa att 691  
 Pro Ser Asp Glu Gly Glu Asp Lys Ile Gln Glu Ile Ile Glu Glu Ile  
 185 190 195  
 gac ggt cga atc cgc gag ctt tgg aaa agc att caa tta tcg caa aac 739  
 Asp Gly Arg Ile Arg Glu Leu Trp Lys Ser Ile Gln Leu Ser Gln Asn  
 200 205 210  
 taggcagtca aaggtctggc acc 762

<210> 124  
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 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 124  
 Met Thr Gly Gln Ala Ala Pro Asn Leu His Thr Asn Ile Leu Asn Arg  
 1 5 10 15  
 Ile Ala Asn Glu Leu Ala Leu Thr Tyr Gln Gly Val Phe Ser Ala Glu  
 20 25 30  
 Thr Ile Asn Arg Tyr Ile Phe Glu Ser Tyr Val Ser Leu Ala Arg Thr  
 35 40 45  
 Ala Lys Ile His Thr His Leu Pro Ile Leu Ala Glu Gly Phe Ala Lys  
 50 55 60  
 Asp Arg Leu His Ala Leu Ala Val Ala Glu Gly Lys Val Ala Ser Pro  
 65 70 75 80  
 Val Pro Gln Val Leu Phe Ile Cys Val His Asn Ala Gly Arg Ser Gln  
 85 90 95  
 Ile Ala Ser Ala Leu Leu Ser His Tyr Ala Gly Ser Ser Val Glu Val  
 100 105 110  
 Arg Ser Ala Gly Ser Leu Pro Ala Ser Glu Ile His Pro Leu Val Leu  
 115 120 125  
 Glu Ile Leu Ser Glu Arg Gly Val Asn Ile Ser Asp Ala Phe Pro Lys

130	135	140	
Pro Leu Thr Asp Asp Val Ile Arg Ala Ser Asp Tyr Val Ile Thr Met			
145	150	155	160
Gly Cys Gly Asp Val Cys Pro Met Tyr Pro Gly Lys His Tyr Leu Asp			
	165	170	175
Trp Glu Leu Ala Asp Pro Ser Asp Glu Gly Glu Asp Lys Ile Gln Glu			
	180	185	190
Ile Ile Glu Glu Ile Asp Gly Arg Ile Arg Glu Leu Trp Lys Ser Ile			
	195	200	205
Gln Leu Ser Gln Asn			
210			

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<220>  
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 <223> RXA02205

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 Val Asn Glu Glu Ile  
 1 5  
 acc ctc cta gcc gca gca gca gat cct gcc gca act gaa aat att ggc 163  
 Thr Leu Leu Ala Ala Ala Ala Asp Pro Ala Ala Thr Glu Asn Ile Gly  
 10 15 20  
 tgg gta caa acc att gtg ctc tcc atc gtt caa ggc ctc aca gag ttc 211  
 Trp Val Gln Thr Ile Val Leu Ser Ile Val Gln Gly Leu Thr Glu Phe  
 25 30 35  
 ctg ccg atc agc tcc agc gga cac ctc cga atc atc tct gag ctg ttc 259  
 Leu Pro Ile Ser Ser Ser Gly His Leu Arg Ile Ile Ser Glu Leu Phe  
 40 45 50  
 tgg ggt gcc gat gcc ggc gcg tcc ttt acc gcc gtg gtt cag ctt ggt 307  
 Trp Gly Ala Asp Ala Gly Ala Ser Phe Thr Ala Val Val Gln Leu Gly  
 55 60 65  
 acc gaa gcc gca gtg ctg gtg ttt ttt gcc aag gaa atc tgg caa atc 355  
 Thr Glu Ala Ala Val Leu Val Phe Phe Ala Lys Glu Ile Trp Gln Ile  
 70 75 80 85  
 atc aca ggt tgg ttc gct ggc gta ttc aat aag gaa cgc cgc gga ttt 403  
 Ile Thr Gly Trp Phe Ala Gly Val Phe Asn Lys Glu Arg Arg Gly Phe

90	95	100	
gaa tac cgc atg ggc tgg atg atc att gtt gcc acc att ccc gtc gtg Glu Tyr Arg Met Gly Trp Met Ile Ile Val Ala Thr Ile Pro Val Val			451
105	110	115	
atc ttg ggt gtg ttg ggc aag gac ctg atc cgt gag gcg ctg cga aat Ile Leu Gly Val Leu Gly Lys Asp Leu Ile Arg Glu Ala Leu Arg Asn			499
120	125	130	
atg tgg atc act gca tcc gtg ctg atc ctg ttc tcc ctg gtg ttc att Met Trp Ile Thr Ala Ser Val Leu Ile Leu Phe Ser Leu Val Phe Ile			547
135	140	145	
ttg gcc gag aag atg ggc aag aag gaa cgc gac tac gac aaa ctg acc Leu Ala Glu Lys Met Gly Lys Lys Glu Arg Asp Tyr Asp Lys Leu Thr			595
150	155	160	165
atg aaa gat gcc atc atc atg ggt ctt gca cag tgt ctt gcg ctg atc Met Lys Asp Ala Ile Ile Met Gly Leu Ala Gln Cys Leu Ala Leu Ile			643
170	175	180	
cct ggc gtg tct cgc tcc ggc ggc acc atc tct gct ggt ttg ttc ctt Pro Gly Val Ser Arg Ser Gly Gly Thr Ile Ser Ala Gly Leu Phe Leu			691
185	190	195	
ggt ctc aag cgt gaa gta gcc acc aag ttc tcc ttc ctg ctg gca atc Gly Leu Lys Arg Glu Val Ala Thr Lys Phe Ser Phe Leu Leu Ala Ile			739
200	205	210	
cct gca gtg ctt ggc tcc ggt ttg tac tcc ctg cct gac gct ttt gcg Pro Ala Val Leu Gly Ser Gly Leu Tyr Ser Leu Pro Asp Ala Phe Ala			787
215	220	225	
cca agc tcc gga caa gct gcc tcc ggc cta cag ctc acc gtg ggt acc Pro Ser Ser Gly Gln Ala Ala Ser Gly Leu Gln Leu Thr Val Gly Thr			835
230	235	240	245
ctg gtt gcc ttc gta gtt ggc tac att tcc att gcg tgg ctg atg aag Leu Val Ala Phe Val Val Gly Tyr Ile Ser Ile Ala Trp Leu Met Lys			883
250	255	260	
ttc gtg gca aac cac tcc ttc agc tgg ttt gct gca tac cgt att cct Phe Val Ala Asn His Ser Phe Ser Trp Phe Ala Ala Tyr Arg Ile Pro			931
265	270	275	
gca ggt ctg ctc gtg atg ctg ctg ctc gca ctg ggc atg ctc aac cca Ala Gly Leu Leu Val Met Leu Leu Leu Ala Leu Gly Met Leu Asn Pro			979
280	285	290	
taaaattcct gtacatctta aaa			1002

&lt;210&gt; 126

&lt;211&gt; 293

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 126

Val Asn Glu Glu Ile Thr Leu Leu Ala Ala Ala Asp Pro Ala Ala  
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Thr Glu Asn Ile Gly Trp Val Gln Thr Ile Val Leu Ser Ile Val Gln  
 20 25 30

Gly Leu Thr Glu Phe Leu Pro Ile Ser Ser Ser Gly His Leu Arg Ile  
 35 40 45

Ile Ser Glu Leu Phe Trp Gly Ala Asp Ala Gly Ala Ser Phe Thr Ala  
 50 55 60

Val Val Gln Leu Gly Thr Glu Ala Ala Val Leu Val Phe Phe Ala Lys  
 65 70 75 80

Glu Ile Trp Gln Ile Ile Thr Gly Trp Phe Ala Gly Val Phe Asn Lys  
 85 90 95

Glu Arg Arg Gly Phe Glu Tyr Arg Met Gly Trp Met Ile Ile Val Ala  
 100 105 110

Thr Ile Pro Val Val Ile Leu Gly Val Leu Gly Lys Asp Leu Ile Arg  
 115 120 125

Glu Ala Leu Arg Asn Met Trp Ile Thr Ala Ser Val Leu Ile Leu Phe  
 130 135 140

Ser Leu Val Phe Ile Leu Ala Glu Lys Met Gly Lys Lys Glu Arg Asp  
 145 150 155 160

Tyr Asp Lys Leu Thr Met Lys Asp Ala Ile Ile Met Gly Leu Ala Gln  
 165 170 175

Cys Leu Ala Leu Ile Pro Gly Val Ser Arg Ser Gly Gly Thr Ile Ser  
 180 185 190

Ala Gly Leu Phe Leu Gly Leu Lys Arg Glu Val Ala Thr Lys Phe Ser  
 195 200 205

Phe Leu Leu Ala Ile Pro Ala Val Leu Gly Ser Gly Leu Tyr Ser Leu  
 210 215 220

Pro Asp Ala Phe Ala Pro Ser Ser Gly Gln Ala Ala Ser Gly Leu Gln  
 225 230 235 240

Leu Thr Val Gly Thr Leu Val Ala Phe Val Val Gly Tyr Ile Ser Ile  
 245 250 255

Ala Trp Leu Met Lys Phe Val Ala Asn His Ser Phe Ser Trp Phe Ala  
 260 265 270

Ala Tyr Arg Ile Pro Ala Gly Leu Leu Val Met Leu Leu Leu Ala Leu  
 275 280 285

Gly Met Leu Asn Pro

290

<210> 127  
 <211> 975  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(952)  
 <223> RXA00900

&lt;400&gt; 127

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tagtgatcgc acgcctggcg caggggcttg gcggcggtgc gtg cgt ggt att gcg 115
                               Val Arg Gly Ile Ala
                               1           5

cgc gcg atc gtg cca gac ctt gaa cgc gga caa aag gct gcg cac gcc 163
Arg Ala Ile Val Pro Asp Leu Glu Arg Gly Gln Lys Ala Ala His Ala
          10           15           20

ttt gca ctg ctg atg att att cag gga att gct ccc gtg gta gct ccg 211
Phe Ala Leu Leu Met Ile Ile Gln Gly Ile Ala Pro Val Val Ala Pro
          25           30           35

ctc att ggt ggt gtg ctg gtc ggg cct ttt ggc tgg cgg gga att ttc 259
Leu Ile Gly Gly Val Leu Val Gly Pro Phe Gly Trp Arg Gly Ile Phe
          40           45           50

tgg gca ctt gca ctg gtg aat ttt gcg cag ctg ctt gtt gct ttg ctg 307
Trp Ala Leu Ala Leu Val Asn Phe Ala Gln Leu Leu Val Ala Leu Leu
          55           60           65

cag att aag gag tcg aag cca gtt gaa gag cgt acc gca gca gga ctt 355
Gln Ile Lys Glu Ser Lys Pro Val Glu Glu Arg Thr Ala Ala Gly Leu
          70           75           80           85

ggc gga atg ctg tcc aac tat gtc ttt gtg ctg aag aat cct caa ttt 403
Gly Gly Met Leu Ser Asn Tyr Val Phe Val Leu Lys Asn Pro Gln Phe
          90           95           100

ttg gca tat gta ttc aca ttg ggg ctg tct ttt ggg gcg atg ttc tcc 451
Leu Ala Tyr Val Phe Thr Leu Gly Leu Ser Phe Gly Ala Met Phe Ser
          105           110           115

tac att tcg gcg tcg ccg ttc gtg ctg cag aat caa atg ggc att ccg 499
Tyr Ile Ser Ala Ser Pro Phe Val Leu Gln Asn Gln Met Gly Ile Pro
          120           125           130

gta ctg ctg tat tcc att att ttc gga gtg aat gct ttt ggt ttg att 547
Val Leu Leu Tyr Ser Ile Ile Phe Gly Val Asn Ala Phe Gly Leu Ile
          135           140           145

gtg ggc gga atg gtc aat agg cga ctt ctg cag cgg att cat cca cac 595

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Val Gly Gly Met Val Asn Arg Arg Leu Leu Gln Arg Ile His Pro His  
 150 155 160 165  
 cgc atc atg caa act gtg ctg gcc agt ttt act gtg ctg tgt gcg ctt 643  
 Arg Ile Met Gln Thr Val Leu Ala Ser Phe Thr Val Leu Cys Ala Leu  
 170 175 180  
 ttg ctg att gaa gtg ctg ttt att aat tgg ata ccg ctg ttc ctg ttg 691  
 Leu Leu Ile Glu Val Leu Phe Ile Asn Trp Ile Pro Leu Phe Leu Leu  
 185 190 195  
 ctg ctg ttt ctt atc gtt tcc cat att ccg atg gtt atg gct aac gcg 739  
 Leu Leu Phe Leu Ile Val Ser His Ile Pro Met Val Met Ala Asn Ala  
 200 205 210  
 aca gct ctg gga act gaa gtg gtg cga agc agg gcg gga tcg ggt tct 787  
 Thr Ala Leu Gly Thr Glu Val Val Arg Ser Arg Ala Gly Ser Gly Ser  
 215 220 225  
 gca att ttg ggt ttc gtg caa ttc acg atg ggt gct ttg gtg agt tca 835  
 Ala Ile Leu Gly Phe Val Gln Phe Thr Met Gly Ala Leu Val Ser Ser  
 230 235 240 245  
 ctg gtc gga tta ggc tct gat aag gct ttg act atg gga atc gca atg 883  
 Leu Val Gly Leu Gly Ser Asp Lys Ala Leu Thr Met Gly Ile Ala Met  
 250 255 260  
 act gct tgt gca ctg ctg gcg tgt ggg tgt gcg tac ctg gca ggt cga 931  
 Thr Ala Cys Ala Leu Leu Ala Cys Gly Cys Ala Tyr Leu Ala Gly Arg  
 265 270 275  
 aaa ggt att cca gaa atg aag tagctctagg tggcgtttta agg 975  
 Lys Gly Ile Pro Glu Met Lys  
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<210> 128  
 <211> 284  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 128  
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 Lys Ala Ala His Ala Phe Ala Leu Leu Met Ile Ile Gln Gly Ile Ala  
 20 25 30  
 Pro Val Val Ala Pro Leu Ile Gly Gly Val Leu Val Gly Pro Phe Gly  
 35 40 45  
 Trp Arg Gly Ile Phe Trp Ala Leu Ala Leu Val Asn Phe Ala Gln Leu  
 50 55 60  
 Leu Val Ala Leu Leu Gln Ile Lys Glu Ser Lys Pro Val Glu Glu Arg  
 65 70 75 80

Thr	Ala	Ala	Gly	Leu	Gly	Gly	Met	Leu	Ser	Asn	Tyr	Val	Phe	Val	Leu	
			85						90					95		
Lys	Asn	Pro	Gln	Phe	Leu	Ala	Tyr	Val	Phe	Thr	Leu	Gly	Leu	Ser	Phe	
			100					105					110			
Gly	Ala	Met	Phe	Ser	Tyr	Ile	Ser	Ala	Ser	Pro	Phe	Val	Leu	Gln	Asn	
		115					120					125				
Gln	Met	Gly	Ile	Pro	Val	Leu	Leu	Tyr	Ser	Ile	Ile	Phe	Gly	Val	Asn	
	130					135					140					
Ala	Phe	Gly	Leu	Ile	Val	Gly	Gly	Met	Val	Asn	Arg	Arg	Leu	Leu	Gln	
145					150					155					160	
Arg	Ile	His	Pro	His	Arg	Ile	Met	Gln	Thr	Val	Leu	Ala	Ser	Phe	Thr	
				165					170					175		
Val	Leu	Cys	Ala	Leu	Leu	Leu	Ile	Glu	Val	Leu	Phe	Ile	Asn	Trp	Ile	
			180					185					190			
Pro	Leu	Phe	Leu	Leu	Leu	Leu	Phe	Leu	Ile	Val	Ser	His	Ile	Pro	Met	
		195					200					205				
Val	Met	Ala	Asn	Ala	Thr	Ala	Leu	Gly	Thr	Glu	Val	Val	Arg	Ser	Arg	
	210					215					220					
Ala	Gly	Ser	Gly	Ser	Ala	Ile	Leu	Gly	Phe	Val	Gln	Phe	Thr	Met	Gly	
225					230					235					240	
Ala	Leu	Val	Ser	Ser	Leu	Val	Gly	Leu	Gly	Ser	Asp	Lys	Ala	Leu	Thr	
				245					250					255		
Met	Gly	Ile	Ala	Met	Thr	Ala	Cys	Ala	Leu	Leu	Ala	Cys	Gly	Cys	Ala	
			260					265					270			
Tyr	Leu	Ala	Gly	Arg	Lys	Gly	Ile	Pro	Glu	Met	Lys					
		275					280									

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<210> 129
<211> 537
<212> DNA
<213> Corynebacterium glutamicum
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<222> (101)..(514)  
<223> RXN00901
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aaataccccc aaatcttcga tatagataca cgagacagtg atg cag aaa aaa caa 115
                                         Met Gln Lys Lys Gln
                                         1           5
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cag ctg agc acc gcc ctg att atg gga ttg gca tta ttg tca gcc agc 163  
 Gln Leu Ser Thr Ala Leu Ile Met Gly Leu Ala Leu Leu Ser Ala Ser  
                   10                  15                  20

tcc gcg cta gcg act gat atg tat ttg ccg gca atg cct ggt att gcg 211  
 Ser Ala Leu Ala Thr Asp Met Tyr Leu Pro Ala Met Pro Gly Ile Ala  
                   25                  30                  35

gaa gat ttg ggg aca act gca ccg atg gtg cag tta act ctt tct tcc 259  
 Glu Asp Leu Gly Thr Thr Ala Pro Met Val Gln Leu Thr Leu Ser Ser  
                   40                  45                  50

ttt atg gct gga atg gcg att ggc caa ttg atc att ggt cct ttg tcg 307  
 Phe Met Ala Gly Met Ala Ile Gly Gln Leu Ile Ile Gly Pro Leu Ser  
                   55                  60                  65

gat caa ttg gga agg aaa ggc ctg ctc gtt gca ggt gcg gtg gct gcg 355  
 Asp Gln Leu Gly Arg Lys Gly Leu Leu Val Ala Gly Ala Val Ala Ala  
                   70                  75                  80                  85

ctg gtc gct agt gtg gtg tgc gcg ctg gcg ccg tcg ata agc gta tta 403  
 Leu Val Ala Ser Val Val Cys Ala Leu Ala Pro Ser Ile Ser Val Leu  
                   90                  95                  100

gtg atc gca cgc ctg gtg cag ggg ctt ggc ggc ggt gcg tgc gtg gta 451  
 Val Ile Ala Arg Leu Val Gln Gly Leu Gly Gly Gly Ala Cys Val Val  
                   105                  110                  115

ttg cgc gcg cga tcg tgc cag acc ttg aac gcg gac aaa agg ctg cgc 499  
 Leu Arg Ala Arg Ser Cys Gln Thr Leu Asn Ala Asp Lys Arg Leu Arg  
                   120                  125                  130

acg cct ttg cac tgc tgatgattat tcaggggaatt gct 537  
 Thr Pro Leu His Cys  
                   135

&lt;210&gt; 130

&lt;211&gt; 138

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 130

Met Gln Lys Lys Gln Gln Leu Ser Thr Ala Leu Ile Met Gly Leu Ala  
   1                  5                  10                  15

Leu Leu Ser Ala Ser Ser Ala Leu Ala Thr Asp Met Tyr Leu Pro Ala  
                   20                  25                  30

Met Pro Gly Ile Ala Glu Asp Leu Gly Thr Thr Ala Pro Met Val Gln  
                   35                  40                  45

Leu Thr Leu Ser Ser Phe Met Ala Gly Met Ala Ile Gly Gln Leu Ile  
                   50                  55                  60

Ile Gly Pro Leu Ser Asp Gln Leu Gly Arg Lys Gly Leu Leu Val Ala  
   65                  70                  75                  80

<400> 131																
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agtgatgcag aaaaaacaac agctgagcac cgccctgatt																115
										atg	gga	ttg	gca	tta		
										Met	Gly	Leu	Ala	Leu		
										1				5		
ttg tca gcc agc tcc gcg cta gcg act gat atg tat ttg ccg gca atg																163
Leu	Ser	Ala	Ser	Ser	Ala	Leu	Ala	Thr	Asp	Met	Tyr	Leu	Pro	Ala	Met	
				10					15					20		
cct ggt att gcg gaa gat ttg ggg aca act gca ccg atg gtg cag tta																211
Pro	Gly	Ile	Ala	Glu	Asp	Leu	Gly	Thr	Thr	Ala	Pro	Met	Val	Gln	Leu	
			25					30					35			
act ctt tct tcc ttt atg gct gga atg gcg att ggc caa ttg atc att																259
Thr	Leu	Ser	Ser	Phe	Met	Ala	Gly	Met	Ala	Ile	Gly	Gln	Leu	Ile	Ile	
		40					45					50				
ggt cct ttg tcg gat caa ttg gga agg aaa ggc ctg ctc gtt gca ggt																307
Gly	Pro	Leu	Ser	Asp	Gln	Leu	Gly	Arg	Lys	Gly	Leu	Leu	Val	Ala	Gly	
	55					60					65					
gcg gtg gct gcg ctg gtc gct agt gtg gtg tgc gcg ctg gcg ccg tcg																355
Ala	Val	Ala	Ala	Leu	Val	Ala	Ser	Val	Val	Cys	Ala	Leu	Ala	Pro	Ser	
70					75					80					85	
ata agc gta tta gtg atc gca cgc ctg gtg cag ggg ctt ggc ggc ggt																403
Ile	Ser	Val	Leu	Val	Ile	Ala	Arg	Leu	Val	Gln	Gly	Leu	Gly	Gly	Gly	
				90					95					100		
gcg tgc gtg gta ttg cgc gcg cga tcg tgc cag acc ttg aac gcg gac																451
Ala	Cys	Val	Val	Leu	Arg	Ala	Arg	Ser	Cys	Gln	Thr	Leu	Asn	Ala	Asp	

105	110	115	
aaa agg ctg cgc acg cct ttg cac tgc tgatgattat tcagggaatt			498
Lys Arg Leu Arg Thr Pro Leu His Cys			
120	125		

gct	501
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<210> 132  
 <211> 126  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 132  
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 Tyr Leu Pro Ala Met Pro Gly Ile Ala Glu Asp Leu Gly Thr Thr Ala  
 20 25 30  
 Pro Met Val Gln Leu Thr Leu Ser Ser Phe Met Ala Gly Met Ala Ile  
 35 40 45  
 Gly Gln Leu Ile Ile Gly Pro Leu Ser Asp Gln Leu Gly Arg Lys Gly  
 50 55 60  
 Leu Leu Val Ala Gly Ala Val Ala Ala Leu Val Ala Ser Val Val Cys  
 65 70 75 80  
 Ala Leu Ala Pro Ser Ile Ser Val Leu Val Ile Ala Arg Leu Val Gln  
 85 90 95  
 Gly Leu Gly Gly Gly Ala Cys Val Val Leu Arg Ala Arg Ser Cys Gln  
 100 105 110  
 Thr Leu Asn Ala Asp Lys Arg Leu Arg Thr Pro Leu His Cys  
 115 120 125

<210> 133  
 <211> 1299  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1276)  
 <223> RXA00289

<400> 133  
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 Met Ser Thr Thr Thr  
 1 5

gcg ccc gaa gca cgg ttt cct gtc gtc cct ttg acc gcc atg agt ttc	163
Ala Pro Glu Ala Arg Phe Pro Val Val Pro Leu Thr Ala Met Ser Phe	
10 15 20	
gcg gca ttt gtt tat gtc acg ttc gag atg ttt gca gtt ggc ctc atc	211
Ala Ala Phe Val Tyr Val Thr Phe Glu Met Phe Ala Val Gly Leu Ile	
25 30 35	
aag ccg atg gcc agc gat ctt gga gtg tca gaa tcc agc atc ggc ctg	259
Lys Pro Met Ala Ser Asp Leu Gly Val Ser Glu Ser Ser Ile Gly Leu	
40 45 50	
ttg atg act gtg tat gcg act gtc gtt gcc gtg gtg acg atc cct gcc	307
Leu Met Thr Val Tyr Ala Thr Val Val Ala Val Val Thr Ile Pro Ala	
55 60 65	
atg ttg tgg gtt tct cga ttt aac aag cgc aca gtt ttc ctg att act	355
Met Leu Trp Val Ser Arg Phe Asn Lys Arg Thr Val Phe Leu Ile Thr	
70 75 80 85	
ctg gca ttt ttg gcc acg ggc att gtt gtt cag gca ctg acc gtt aat	403
Leu Ala Phe Leu Ala Thr Gly Ile Val Val Gln Ala Leu Thr Val Asn	
90 95 100	
tat gga atg cta gcc atc ggc cgc act atc gca gca ttg act cac ggg	451
Tyr Gly Met Leu Ala Ile Gly Arg Thr Ile Ala Ala Leu Thr His Gly	
105 110 115	
gtg ttt tgg gca ctt gtt ggg cca atg gca gcg cgt atg tcc cca ggt	499
Val Phe Trp Ala Leu Val Gly Pro Met Ala Ala Arg Met Ser Pro Gly	
120 125 130	
cac act ggt cgt gca gta ggc gtt gtg tcg att gga tca acc atg gcg	547
His Thr Gly Arg Ala Val Gly Val Val Ser Ile Gly Ser Thr Met Ala	
135 140 145	
ctg gtc gtt ggt tct ccg ctg gca aca tgg atc ggt gaa ctc atc gga	595
Leu Val Val Gly Ser Pro Leu Ala Thr Trp Ile Gly Glu Leu Ile Gly	
150 155 160 165	
tgg cgt cct gcc acc tgg att ctt ggt gcg ctg acc att gcg gcc gtg	643
Trp Arg Pro Ala Thr Trp Ile Leu Gly Ala Leu Thr Ile Ala Ala Val	
170 175 180	
gct gta ctc att cca acc gtt cca tca ctg cca cca ctt cca gac acg	691
Ala Val Leu Ile Pro Thr Val Pro Ser Leu Pro Pro Leu Pro Asp Thr	
185 190 195	
gaa tca gag tcc aaa gaa aag aaa tcc ctt cca tgg ggt ctc att tcc	739
Glu Ser Glu Ser Lys Glu Lys Lys Ser Leu Pro Trp Gly Leu Ile Ser	
200 205 210	
ctg gtc att ttc ctt ctc ctt gcc gtc acc ggt gtt ttt gct gcc tac	787
Leu Val Ile Phe Leu Leu Leu Ala Val Thr Gly Val Phe Ala Ala Tyr	
215 220 225	
acc tac ctt ggc ctc atc atc gct gaa aca gca ggg gac agc ttc gtg	835



Thr Tyr Leu Gly Leu Ile Ile Ala Glu Thr Ala Gly Asp Ser Phe Val  
 230 235 240 245  
 tcc att ggc ttg ttc gcc ttc ggt gca ctc gga ctc att ggc gtg aca 883  
 Ser Ile Gly Leu Phe Ala Phe Gly Ala Leu Gly Leu Ile Gly Val Thr  
 250 255 260  
 gtg gca acc cga act gtg gat caa cgc atg ctg cgt gga agt gtt cac 931  
 Val Ala Thr Arg Thr Val Asp Gln Arg Met Leu Arg Gly Ser Val His  
 265 270 275  
 acc acc act ttg ttt gtc att gct gca att ctc gga cag atc gca ttc 979  
 Thr Thr Thr Leu Phe Val Ile Ala Ala Ile Leu Gly Gln Ile Ala Phe  
 280 285 290  
 gga tta gag ggc aca cta gcc gta gta gct atc ttc ctt gca gtc acc 1027  
 Gly Leu Glu Gly Thr Leu Ala Val Val Ala Ile Phe Leu Ala Val Thr  
 295 300 305  
 gtg ttt ggt gga gca tac ggc gct ctc cca acc ctg gga acc acc atc 1075  
 Val Phe Gly Gly Ala Tyr Gly Ala Leu Pro Thr Leu Gly Thr Thr Ile  
 310 315 320 325  
 ttc ctc cat gcg ggt cgc gac cac cca gat act gca tcc tcc att tat 1123  
 Phe Leu His Ala Gly Arg Asp His Pro Asp Thr Ala Ser Ser Ile Tyr  
 330 335 340  
 gtg gtc act tac caa gtg ggt atc gcg tct ggc gcg gca ctt ggc gcg 1171  
 Val Val Thr Tyr Gln Val Gly Ile Ala Ser Gly Ala Ala Leu Gly Ala  
 345 350 355  
 atg gct gtg gat gcc gat tgg gtt gct ggc act ttg tgg atc atg gct 1219  
 Met Ala Val Asp Ala Asp Trp Val Ala Gly Thr Leu Trp Ile Met Ala  
 360 365 370  
 gga ctg tca ttg gct tcc acg ttg gcc ttg gcg ctg tgg tcc cgc ccg 1267  
 Gly Leu Ser Leu Ala Ser Thr Leu Ala Leu Ala Leu Trp Ser Arg Pro  
 375 380 385  
 cta ctg aag tagcagccca aattcagccc act 1299  
 Leu Leu Lys  
 390

<210> 134  
 <211> 392  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 134  
 Met Ser Thr Thr Thr Ala Pro Glu Ala Arg Phe Pro Val Val Pro Leu  
 1 5 10 15  
 Thr Ala Met Ser Phe Ala Ala Phe Val Tyr Val Thr Phe Glu Met Phe  
 20 25 30  
 Ala Val Gly Leu Ile Lys Pro Met Ala Ser Asp Leu Gly Val Ser Glu

35					40					45					
Ser	Ser	Ile	Gly	Leu	Leu	Met	Thr	Val	Tyr	Ala	Thr	Val	Val	Ala	Val
50					55					60					
Val	Thr	Ile	Pro	Ala	Met	Leu	Trp	Val	Ser	Arg	Phe	Asn	Lys	Arg	Thr
65					70					75					80
Val	Phe	Leu	Ile	Thr	Leu	Ala	Phe	Leu	Ala	Thr	Gly	Ile	Val	Val	Gln
				85					90					95	
Ala	Leu	Thr	Val	Asn	Tyr	Gly	Met	Leu	Ala	Ile	Gly	Arg	Thr	Ile	Ala
			100					105					110		
Ala	Leu	Thr	His	Gly	Val	Phe	Trp	Ala	Leu	Val	Gly	Pro	Met	Ala	Ala
		115					120					125			
Arg	Met	Ser	Pro	Gly	His	Thr	Gly	Arg	Ala	Val	Gly	Val	Val	Ser	Ile
	130					135					140				
Gly	Ser	Thr	Met	Ala	Leu	Val	Val	Gly	Ser	Pro	Leu	Ala	Thr	Trp	Ile
145					150					155					160
Gly	Glu	Leu	Ile	Gly	Trp	Arg	Pro	Ala	Thr	Trp	Ile	Leu	Gly	Ala	Leu
				165					170					175	
Thr	Ile	Ala	Ala	Val	Ala	Val	Leu	Ile	Pro	Thr	Val	Pro	Ser	Leu	Pro
			180					185					190		
Pro	Leu	Pro	Asp	Thr	Glu	Ser	Glu	Ser	Lys	Glu	Lys	Lys	Ser	Leu	Pro
		195					200					205			
Trp	Gly	Leu	Ile	Ser	Leu	Val	Ile	Phe	Leu	Leu	Leu	Ala	Val	Thr	Gly
	210					215					220				
Val	Phe	Ala	Ala	Tyr	Thr	Tyr	Leu	Gly	Leu	Ile	Ile	Ala	Glu	Thr	Ala
225					230					235					240
Gly	Asp	Ser	Phe	Val	Ser	Ile	Gly	Leu	Phe	Ala	Phe	Gly	Ala	Leu	Gly
			245						250					255	
Leu	Ile	Gly	Val	Thr	Val	Ala	Thr	Arg	Thr	Val	Asp	Gln	Arg	Met	Leu
		260						265					270		
Arg	Gly	Ser	Val	His	Thr	Thr	Thr	Leu	Phe	Val	Ile	Ala	Ala	Ile	Leu
		275					280					285			
Gly	Gln	Ile	Ala	Phe	Gly	Leu	Glu	Gly	Thr	Leu	Ala	Val	Val	Ala	Ile
	290					295					300				
Phe	Leu	Ala	Val	Thr	Val	Phe	Gly	Gly	Ala	Tyr	Gly	Ala	Leu	Pro	Thr
305					310					315					320
Leu	Gly	Thr	Thr	Ile	Phe	Leu	His	Ala	Gly	Arg	Asp	His	Pro	Asp	Thr
			325						330					335	
Ala	Ser	Ser	Ile	Tyr	Val	Val	Thr	Tyr	Gln	Val	Gly	Ile	Ala	Ser	Gly

340						345						350			
Ala	Ala	Leu	Gly	Ala	Met	Ala	Val	Asp	Ala	Asp	Trp	Val	Ala	Gly	Thr
355						360						365			
Leu	Trp	Ile	Met	Ala	Gly	Leu	Ser	Leu	Ala	Ser	Thr	Leu	Ala	Leu	Ala
370						375						380			
Leu	Trp	Ser	Arg	Pro	Leu	Leu	Lys								
385						390									

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<210> 135
<211> 420
<212> DNA
<213> Corynebacterium glutamicum
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<220>
<221> CDS
<222> (101)..(397)
<223> RXN01984
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caatagtgcc ggtgagggag ctgtccgata ttgtgcttac atg cac gaa tct gga 115															
Met His Glu Ser Gly 5															
1															
aaa aat cct gtc aag gtt gtc gac tcg cag gca cca caa gga cgc ggt 163															
Lys Asn Pro Val Lys Val Val Asp Ser Gln Ala Pro Gln Gly Arg Gly 20															
10 15															
ggg cat atc ggc gga cat atc aaa cgc cgc ccg att cct agg caa acg 211															
Gly His Ile Gly Gly His Ile Lys Arg Arg Pro Ile Pro Arg Gln Thr 35															
25 30															
gaa att tcc gag gtt cgt cga tat atc gtc atg act gcc ctc gca ctc 259															
Glu Ile Ser Glu Val Arg Arg Tyr Ile Val Met Thr Ala Leu Ala Leu 50															
40 45															
ggt ggc ttc gcc atc ggt gtg acg gaa ttt gtc tcc atg ggt ctg ctc 307															
Gly Gly Phe Ala Ile Gly Val Thr Glu Phe Val Ser Met Gly Leu Leu 65															
55 60															
agc gcg atc gcc tcc gac ttt gag atc tcc gaa gac caa gcc gga cac 355															
Ser Ala Ile Ala Ser Asp Phe Glu Ile Ser Glu Asp Gln Ala Gly His 85															
70 75 80															
atc atc acc atc tac gcc ctc gcg tgg ttg tgg gtg ccc cgc 397															
Ile Ile Thr Ile Tyr Ala Leu Ala Trp Leu Trp Val Pro Arg 95															
90 95															
tqatcacagc gtttaccggc aaa 420															

<210> 136

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<400> 136
Met His Glu Ser Gly Lys Asn Pro Val Lys Val Val Asp Ser Gln Ala
   1                               5          10              15

Pro Gln Gly Arg Gly Gly His Ile Gly Gly His Ile Lys Arg Arg Pro
      20                25              30

Ile Pro Arg Gln Thr Glu Ile Ser Glu Val Arg Arg Tyr Ile Val Met
      35                40              45

Thr Ala Leu Ala Leu Gly Gly Phe Ala Ile Gly Val Thr Glu Phe Val
     50                55              60

Ser Met Gly Leu Leu Ser Ala Ile Ala Ser Asp Phe Glu Ile Ser Glu
    65                70              75              80

Asp Gln Ala Gly His Ile Ile Thr Ile Tyr Ala Leu Ala Trp Leu Trp
           85                90              95

Val Pro Arg
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<220>  
<221> CDS  
<222> (101)..(379)  
<223> FRXA01984
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180

Gly Gly Phe Ala Ile Gly Val Thr Glu Phe Val Ser Met Gly Leu Leu  
 55 60 65

agc gcg atc gcc tcc gac ttt gag atc tcc gaa gac caa gcc gga cac 355  
 Ser Ala Ile Ala Ser Asp Phe Glu Ile Ser Glu Asp Gln Ala Gly His  
 70 75 80 85

atc atc acc atc tac gcc ctc gcg 379  
 Ile Ile Thr Ile Tyr Ala Leu Ala  
 90

<210> 138  
 <211> 93  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 138  
 Met His Glu Ser Gly Lys Asn Pro Val Lys Val Val Asp Ser Gln Ala  
 1 5 10 15

Pro Gln Gly Arg Gly Gly His Ile Gly Gly His Ile Lys Arg Arg Pro  
 20 25 30

Ile Pro Arg Gln Thr Glu Ile Ser Glu Val Arg Arg Tyr Ile Val Met  
 35 40 45

Thr Ala Leu Ala Leu Gly Gly Phe Ala Ile Gly Val Thr Glu Phe Val  
 50 55 60

Ser Met Gly Leu Leu Ser Ala Ile Ala Ser Asp Phe Glu Ile Ser Glu  
 65 70 75 80

Asp Gln Ala Gly His Ile Ile Thr Ile Tyr Ala Leu Ala  
 85 90

<210> 139  
 <211> 735  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(712)  
 <223> RXA00109

<400> 139  
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cggcgaaaag gaagtttcgc ccatctatga gaggttgaat gtg gct tca gag aag 115  
 Val Ala Ser Glu Lys  
 1 5

aat cta aaa ttg cgt acc ttg gcg gca gct gct ggg gtg ttg ggc gtt 163  
 Asn Leu Lys Leu Arg Thr Leu Ala Ala Ala Ala Gly Val Leu Gly Val  
 10 15 20

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ggc gcg atg tcg atg ctc gtg gct ccg cag gct gct gcc cat gat gtg 211
Gly Ala Met Ser Met Leu Val Ala Pro Gln Ala Ala Ala His Asp Val
      25                      30                      35

gtg gtg gat tct aat cct gaa aat ggc agt gtc gtt gat gag ttc ccg 259
Val Val Asp Ser Asn Pro Glu Asn Gly Ser Val Val Asp Glu Phe Pro
      40                      45                      50

gag acc att gag ttg gag ttt tcc ggt att cct cag gat ctg ttc aca 307
Glu Thr Ile Glu Leu Glu Phe Ser Gly Ile Pro Gln Asp Leu Phe Thr
      55                      60                      65

aca gtt gca ttg agc aat gcg gat tcc gga gag gtg tta act tct gga 355
Thr Val Ala Leu Ser Asn Ala Asp Ser Gly Glu Val Leu Thr Ser Gly
      70                      75                      80                      85

act cct cag ctt gag ggg cag cac ttg agc tat gaa gtg cca tct gat 403
Thr Pro Gln Leu Glu Gly Gln His Leu Ser Tyr Glu Val Pro Ser Asp
      90                      95                      100

gtg cag acg gga gct ggt aac tac att ttg ggt ttc cag atc act tct 451
Val Gln Thr Gly Ala Gly Asn Tyr Ile Leu Gly Phe Gln Ile Thr Ser
      105                      110                      115

tct gat ggt cac gct act aaa ggt tca atc tct ttt gag gtg aca ggc 499
Ser Asp Gly His Ala Thr Lys Gly Ser Ile Ser Phe Glu Val Thr Gly
      120                      125                      130

tct gct gaa acg aca aca gag aca aca gca gag acg aca act gag tca 547
Ser Ala Glu Thr Thr Thr Glu Thr Thr Ala Glu Thr Thr Thr Glu Ser
      135                      140                      145

gca gca acc act gac acc tca gag acc acc gaa gca gag aca act gaa 595
Ala Ala Thr Thr Asp Thr Ser Glu Thr Thr Glu Ala Glu Thr Thr Glu
      150                      155                      160                      165

act gct gat gaa act tct gga att cct gcg ccg tgg aat tgg gtt ttg 643
Thr Ala Asp Glu Thr Ser Gly Ile Pro Ala Pro Trp Asn Trp Val Leu
      170                      175                      180

agc atc gtg gcg gtg ctt gtt gtt gca agt gcc atc gtc atg atg att 691
Ser Ile Val Ala Val Leu Val Val Ala Ser Ala Ile Val Met Met Ile
      185                      190                      195

gca aag aat cgt aac cag aaa taagagggtt tattcaccat gaa 735
Ala Lys Asn Arg Asn Gln Lys
      200

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<210> 140  
 <211> 204  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 140  
 Val Ala Ser Glu Lys Asn Leu Lys Leu Arg Thr Leu Ala Ala Ala Ala



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<210> 141
<211> 735
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
<221> CDS  
<222> (101)..(712)  
<223> RXA00109
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<400> 141
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cggcgaaaag gaagtttcgc ccatctatga gaggttgaat gtg gct tca gag aag 115
                                         Val Ala Ser Glu Lys
                                         1                               5
aat cta aaa ttg cgt acc ttg gcg gca gct gct ggg gtg ttg ggc gtt 163
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Asn	Leu	Lys	Leu	Arg	Thr	Leu	Ala	Ala	Ala	Ala	Gly	Val	Leu	Gly	Val		
				10					15					20			
ggc	gcg	atg	tcg	atg	ctc	gtg	gct	ccg	cag	gct	gct	gcc	cat	gat	gtg	211	
Gly	Ala	Met	Ser	Met	Leu	Val	Ala	Pro	Gln	Ala	Ala	Ala	His	Asp	Val		
			25					30					35				
gtg	gtg	gat	tct	aat	cct	gaa	aat	ggc	agt	gtc	gtt	gat	gag	ttc	ccg	259	
Val	Val	Asp	Ser	Asn	Pro	Glu	Asn	Gly	Ser	Val	Val	Asp	Glu	Phe	Pro		
			40				45					50					
gag	acc	att	gag	ttg	gag	ttt	tcc	ggc	att	cct	cag	gat	ctg	ttc	aca	307	
Glu	Thr	Ile	Glu	Leu	Glu	Phe	Ser	Gly	Ile	Pro	Gln	Asp	Leu	Phe	Thr		
	55					60				65							
aca	gtt	gca	ttg	agc	aat	gcg	gat	tcc	gga	gag	gtg	tta	act	tct	gga	355	
Thr	Val	Ala	Leu	Ser	Asn	Ala	Asp	Ser	Gly	Glu	Val	Leu	Thr	Ser	Gly		
	70				75				80						85		
act	cct	cag	ctt	gag	ggg	cag	cac	ttg	agc	tat	gaa	gtg	cca	tct	gat	403	
Thr	Pro	Gln	Leu	Glu	Gly	Gln	His	Leu	Ser	Tyr	Glu	Val	Pro	Ser	Asp		
			90					95						100			
gtg	cag	acg	gga	gct	ggc	aac	tac	att	ttg	ggc	ttc	cag	atc	act	tct	451	
Val	Gln	Thr	Gly	Ala	Gly	Asn	Tyr	Ile	Leu	Gly	Phe	Gln	Ile	Thr	Ser		
			105					110					115				
tct	gat	ggc	cac	gct	act	aaa	ggc	tca	atc	tct	ttt	gag	gtg	aca	ggc	499	
Ser	Asp	Gly	His	Ala	Thr	Lys	Gly	Ser	Ile	Ser	Phe	Glu	Val	Thr	Gly		
		120					125					130					
tct	gct	gaa	acg	aca	aca	gag	aca	aca	gca	gag	acg	aca	act	gag	tca	547	
Ser	Ala	Glu	Thr	Thr	Thr	Glu	Thr	Thr	Ala	Glu	Thr	Thr	Thr	Glu	Ser		
	135					140				145							
gca	gca	acc	act	gac	acc	tca	gag	acc	acc	gaa	gca	gag	aca	act	gaa	595	
Ala	Ala	Thr	Thr	Asp	Thr	Ser	Glu	Thr	Thr	Glu	Ala	Glu	Thr	Thr	Glu		
	150				155					160					165		
act	gct	gat	gaa	act	tct	gga	att	cct	gcg	ccg	tgg	aat	tgg	gtt	ttg	643	
Thr	Ala	Asp	Glu	Thr	Ser	Gly	Ile	Pro	Ala	Pro	Trp	Asn	Trp	Val	Leu		
			170					175						180			
agc	atc	gtg	gcg	gtg	ctt	gtt	gtt	gca	agt	gcc	atc	gtc	atg	atg	att	691	
Ser	Ile	Val	Ala	Val	Leu	Val	Val	Ala	Ser	Ala	Ile	Val	Met	Met	Ile		
		185					190					195					
gca	aag	aat	cgt	aac	cag	aaa	taagagggtt	tattcaccat	gaa							735	
Ala	Lys	Asn	Arg	Asn	Gln	Lys											
		200															

&lt;210&gt; 142

&lt;211&gt; 204

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 142

Val Ala Ser Glu Lys Asn Leu Lys Leu Arg Thr Leu Ala Ala Ala Ala  
 1 5 10 15

Gly Val Leu Gly Val Gly Ala Met Ser Met Leu Val Ala Pro Gln Ala  
 20 25 30

Ala Ala His Asp Val Val Val Asp Ser Asn Pro Glu Asn Gly Ser Val  
 35 40 45

Val Asp Glu Phe Pro Glu Thr Ile Glu Leu Glu Phe Ser Gly Ile Pro  
 50 55 60

Gln Asp Leu Phe Thr Thr Val Ala Leu Ser Asn Ala Asp Ser Gly Glu  
 65 70 75 80

Val Leu Thr Ser Gly Thr Pro Gln Leu Glu Gly Gln His Leu Ser Tyr  
 85 90 95

Glu Val Pro Ser Asp Val Gln Thr Gly Ala Gly Asn Tyr Ile Leu Gly  
 100 105 110

Phe Gln Ile Thr Ser Ser Asp Gly His Ala Thr Lys Gly Ser Ile Ser  
 115 120 125

Phe Glu Val Thr Gly Ser Ala Glu Thr Thr Thr Glu Thr Thr Ala Glu  
 130 135 140

Thr Thr Thr Glu Ser Ala Ala Thr Thr Asp Thr Ser Glu Thr Thr Glu  
 145 150 155 160

Ala Glu Thr Thr Glu Thr Ala Asp Glu Thr Ser Gly Ile Pro Ala Pro  
 165 170 175

Trp Asn Trp Val Leu Ser Ile Val Ala Val Leu Val Val Ala Ser Ala  
 180 185 190

Ile Val Met Met Ile Ala Lys Asn Arg Asn Gln Lys  
 195 200

&lt;210&gt; 143

&lt;211&gt; 864

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(841)

&lt;223&gt; RXA00996

&lt;400&gt; 143

atcttaagcc ttttgtccaa ggctctgagt tcttagtggc ggtatttacc aagaagtaac 60

acctctatct tgcacctgat ctggcgtaga ctcataagtt atg agc acc gta acg 115  
 Met Ser Thr Val Thr  
 1 5

gca gtg cag gtc aac ggc cta aaa gtt tcc ata tcg tcc ggt ttt tca	163
Ala Val Gln Val Asn Gly Leu Lys Val Ser Ile Ser Ser Gly Phe Ser	
10 15 20	
cgc aag aaa aca aaa acg atc ttg cat gat ctc gat ttc acc gta gag	211
Arg Lys Lys Thr Lys Thr Ile Leu His Asp Leu Asp Phe Thr Val Glu	
25 30 35	
acc gga aag atc acg gga ttg ctg ggg cca tcg ggc agc ggc aag aca	259
Thr Gly Lys Ile Thr Gly Leu Leu Gly Pro Ser Gly Ser Gly Lys Thr	
40 45 50	
act ttg atg cgc gcg att gtg gga gtg caa aac ttc gac ggc acc ctt	307
Thr Leu Met Arg Ala Ile Val Gly Val Gln Asn Phe Asp Gly Thr Leu	
55 60 65	
gag gtg ttt gat cag ccc gca ggt gct gcc tct ctg cgc ggg aaa atc	355
Glu Val Phe Asp Gln Pro Ala Gly Ala Ala Ser Leu Arg Gly Lys Ile	
70 75 80 85	
ggc tat gtc acc caa aac gcc agc gta tat cac gat ctg tcg gtg ata	403
Gly Tyr Val Thr Gln Asn Ala Ser Val Tyr His Asp Leu Ser Val Ile	
90 95 100	
gaa aac ctc aag tat ttc ggg gct ctg gct aaa gga acc tcc act cca	451
Glu Asn Leu Lys Tyr Phe Gly Ala Leu Ala Lys Gly Thr Ser Thr Pro	
105 110 115	
cgc acc ccg gaa aag att ctg gag gtc tta gac atc gca gat ctt gct	499
Arg Thr Pro Glu Lys Ile Leu Glu Val Leu Asp Ile Ala Asp Leu Ala	
120 125 130	
caa cgc caa gta tca aca cta tct ggt ggg cag cgc ggc cga gtc tcc	547
Gln Arg Gln Val Ser Thr Leu Ser Gly Gly Gln Arg Gly Arg Val Ser	
135 140 145	
ctt gga tgt gcg ctt att gcc tca cca gaa ctc ttg gtg atg gat gag	595
Leu Gly Cys Ala Leu Ile Ala Ser Pro Glu Leu Leu Val Met Asp Glu	
150 155 160 165	
cca acc gtg ggt ttg gat ccc att acc cgg caa gca ctg tgg gaa gag	643
Pro Thr Val Gly Leu Asp Pro Ile Thr Arg Gln Ala Leu Trp Glu Glu	
170 175 180	
ttc acc acc atc gca aaa gca ggt gct gga gtg gtt atc tcc agt cac	691
Phe Thr Thr Ile Ala Lys Ala Gly Ala Gly Val Val Ile Ser Ser His	
185 190 195	
gtg ttg gag gaa gcc gcg cgg tgc gac aac ctc att ttg ttg cgt gat	739
Val Leu Glu Glu Ala Ala Arg Cys Asp Asn Leu Ile Leu Leu Arg Asp	
200 205 210	
ggt cgg atc atc tgg agg gga aca ccc aca cgc ctt cta gaa gat aca	787
Gly Arg Ile Ile Trp Arg Gly Thr Pro Thr Arg Leu Leu Glu Asp Thr	
215 220 225	

ggc aaa agc tca tac gaa gat gct ttc ttg gct gcc att gac ggg gta 835  
 Gly Lys Ser Ser Tyr Glu Asp Ala Phe Leu Ala Ala Ile Asp Gly Val  
 230 235 240 245

agg tca tgaaccctca ctatctgctt gcc 864  
 Arg Ser

<210> 144

<211> 247

<212> PRT

<213> Corynebacterium glutamicum

<400> 144

Met Ser Thr Val Thr Ala Val Gln Val Asn Gly Leu Lys Val Ser Ile  
 1 5 10 15

Ser Ser Gly Phe Ser Arg Lys Lys Thr Lys Thr Ile Leu His Asp Leu  
 20 25 30

Asp Phe Thr Val Glu Thr Gly Lys Ile Thr Gly Leu Leu Gly Pro Ser  
 35 40 45

Gly Ser Gly Lys Thr Thr Leu Met Arg Ala Ile Val Gly Val Gln Asn  
 50 55 60

Phe Asp Gly Thr Leu Glu Val Phe Asp Gln Pro Ala Gly Ala Ala Ser  
 65 70 75 80

Leu Arg Gly Lys Ile Gly Tyr Val Thr Gln Asn Ala Ser Val Tyr His  
 85 90 95

Asp Leu Ser Val Ile Glu Asn Leu Lys Tyr Phe Gly Ala Leu Ala Lys  
 100 105 110

Gly Thr Ser Thr Pro Arg Thr Pro Glu Lys Ile Leu Glu Val Leu Asp  
 115 120 125

Ile Ala Asp Leu Ala Gln Arg Gln Val Ser Thr Leu Ser Gly Gly Gln  
 130 135 140

Arg Gly Arg Val Ser Leu Gly Cys Ala Leu Ile Ala Ser Pro Glu Leu  
 145 150 155 160

Leu Val Met Asp Glu Pro Thr Val Gly Leu Asp Pro Ile Thr Arg Gln  
 165 170 175

Ala Leu Trp Glu Glu Phe Thr Thr Ile Ala Lys Ala Gly Ala Gly Val  
 180 185 190

Val Ile Ser Ser His Val Leu Glu Glu Ala Ala Arg Cys Asp Asn Leu  
 195 200 205

Ile Leu Leu Arg Asp Gly Arg Ile Ile Trp Arg Gly Thr Pro Thr Arg  
 210 215 220

Leu Leu Glu Asp Thr Gly Lys Ser Ser Tyr Glu Asp Ala Phe Leu Ala  
 225 230 235 240

Ala Ile Asp Gly Val Arg Ser  
 245

<210> 145  
 <211> 2463  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(2440)  
 <223> RXN00829

<400> 145  
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 caagcgcgaa caggcctatg caaacggtag gatatgacac atg caa aaa gct gat 115  
 Met Gln Lys Ala Asp  
 1 5  
 tcc cat gat tgg att tcg gtc cac ggt gcg aat gaa aac aac ctc aaa 163  
 Ser His Asp Trp Ile Ser Val His Gly Ala Asn Glu Asn Asn Leu Lys  
 10 15 20  
 aat gtg tcg gtg cgc atc cct aaa agg cgt ctc acc gtg ttc acg ggt 211  
 Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu Thr Val Phe Thr Gly  
 25 30 35  
 gtg tcg gga tct ggc aag tcc tcg ctg gtg ttc ggc aca att gct gcg 259  
 Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe Gly Thr Ile Ala Ala  
 40 45 50  
 gaa tca cgc cgg ttg atc aac gaa acc tat agc act ttt gtg caa ggt 307  
 Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser Thr Phe Val Gln Gly  
 55 60 65  
 ttc atg ccg tcg atg gca agg ccc gat gtt gac cat ttg gaa ggc atc 355  
 Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp His Leu Glu Gly Ile  
 70 75 80 85  
 acc acg gcg atc atc gtc gat cag gag cag atg ggc gca aac cca cgg 403  
 Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met Gly Ala Asn Pro Arg  
 90 95 100  
 tct acg gtg ggt acc gca act gat gcc acc gcg atg ttg cgc att ttg 451  
 Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala Met Leu Arg Ile Leu  
 105 110 115  
 ttt tcc cga atc gcg gaa cct aac gcg ggt ggc ccg gga gct tat tcc 499  
 Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly Pro Gly Ala Tyr Ser  
 120 125 130  
 ttc aac gtc ccc tct gtt tcc gca tcc ggc gcc atc acg gtg gaa aag 547



Phe	Asn	Val	Pro	Ser	Val	Ser	Ala	Ser	Gly	Ala	Ile	Thr	Val	Glu	Lys	
135						140					145					
ggc	gga	aac	acc	aag	cgg	gag	aaa	gct	acc	ttc	aaa	cgc	acg	ggt	ggc	595
Gly	Gly	Asn	Thr	Lys	Arg	Glu	Lys	Ala	Thr	Phe	Lys	Arg	Thr	Gly	Gly	
150					155					160					165	
atg	tgc	cca	gcg	tgc	gag	ggc	atg	ggc	agg	gcc	tca	gac	atc	gac	ctc	643
Met	Cys	Pro	Ala	Cys	Glu	Gly	Met	Gly	Arg	Ala	Ser	Asp	Ile	Asp	Leu	
				170					175						180	
aaa	gag	ctt	ttc	gac	gcc	tcc	ctc	tcc	ctc	aac	gac	ggc	gcc	ctg	acc	691
Lys	Glu	Leu	Phe	Asp	Ala	Ser	Leu	Ser	Leu	Asn	Asp	Gly	Ala	Leu	Thr	
			185					190					195			
atc	ccc	ggt	tac	acc	cca	ggt	gga	tgg	agt	tat	cgg	atg	tat	tca	gaa	739
Ile	Pro	Gly	Tyr	Thr	Pro	Gly	Gly	Trp	Ser	Tyr	Arg	Met	Tyr	Ser	Glu	
		200					205					210				
tcg	ggc	ctt	ttt	gat	gct	gcc	aag	ccg	att	aag	gat	ttc	acc	gag	gaa	787
Ser	Gly	Leu	Phe	Asp	Ala	Ala	Lys	Pro	Ile	Lys	Asp	Phe	Thr	Glu	Glu	
	215					220					225					
gaa	cgc	cac	aac	ttc	ctt	tat	ctt	gag	ccc	acc	aag	atg	aag	atc	gct	835
Glu	Arg	His	Asn	Phe	Leu	Tyr	Leu	Glu	Pro	Thr	Lys	Met	Lys	Ile	Ala	
230					235					240					245	
ggc	atc	aac	atg	acc	tat	gag	ggt	ctt	atc	ccc	cgc	att	cag	aaa	tcc	883
Gly	Ile	Asn	Met	Thr	Tyr	Glu	Gly	Leu	Ile	Pro	Arg	Ile	Gln	Lys	Ser	
				250					255					260		
atg	ttg	tct	aag	gat	cgc	gaa	ggc	atg	cag	aag	cat	att	cgt	gcg	ttc	931
Met	Leu	Ser	Lys	Asp	Arg	Glu	Gly	Met	Gln	Lys	His	Ile	Arg	Ala	Phe	
			265				270						275			
gtg	gat	cga	gcg	gtt	acc	ttc	att	cct	tgc	cct	gcg	tgt	ggt	gga	act	979
Val	Asp	Arg	Ala	Val	Thr	Phe	Ile	Pro	Cys	Pro	Ala	Cys	Gly	Gly	Thr	
		280					285					290				
cga	tta	gcg	cca	cat	gcc	ttg	gag	tcc	aag	atc	aat	ggc	aaa	aac	atc	1027
Arg	Leu	Ala	Pro	His	Ala	Leu	Glu	Ser	Lys	Ile	Asn	Gly	Lys	Asn	Ile	
	295					300					305					
gct	gag	ttg	tgc	gcg	atg	gag	gtc	cgt	gat	ttg	gcc	aag	tgg	atc	aaa	1075
Ala	Glu	Leu	Cys	Ala	Met	Glu	Val	Arg	Asp	Leu	Ala	Lys	Trp	Ile	Lys	
310					315					320					325	
acg	gtg	gaa	gcc	ccc	tcg	gtt	gct	ccc	ctg	ctc	acc	gca	ctg	act	gaa	1123
Thr	Val	Glu	Ala	Pro	Ser	Val	Ala	Pro	Leu	Leu	Thr	Ala	Leu	Thr	Glu	
				330					335					340		
acc	ctg	gat	aac	ttc	gtg	gag	atc	ggt	ttg	ggc	tat	atc	caa	ctc	gat	1171
Thr	Leu	Asp	Asn	Phe	Val	Glu	Ile	Gly	Leu	Gly	Tyr	Ile	Gln	Leu	Asp	
			345					350					355			
cgc	ccc	gct	ggc	acg	ttg	tct	ggt	ggt	gag	gca	cag	cgc	acc	aag	atg	1219
Arg	Pro	Ala	Gly	Thr	Leu	Ser	Gly	Gly	Glu	Ala	Gln	Arg	Thr	Lys	Met	

360	365	370	
atc cgc cat ttg ggc tct gca ttg act gac gtc acc tat gtt ttt gat			1267
Ile Arg His Leu Gly Ser Ala Leu Thr Asp Val Thr Tyr Val Phe Asp			
375	380	385	
gaa ccc acc gcc ggt ttg cac gcc tac gac att gaa cgc atg aac aag			1315
Glu Pro Thr Ala Gly Leu His Ala Tyr Asp Ile Glu Arg Met Asn Lys			
390	395	400	405
ttg ctg ctc gat ctt cgc gat aaa ggc aat acc gtt tta gtc gtg gag			1363
Leu Leu Leu Asp Leu Arg Asp Lys Gly Asn Thr Val Leu Val Val Glu			
410	415	420	
cac aag ccg gaa acc atc gcc att gca gat cat gtg gtg gac ctt ggg			1411
His Lys Pro Glu Thr Ile Ala Ile Ala Asp His Val Val Asp Leu Gly			
425	430	435	
cca ggt gca ggc gcg ggt gga ggt gaa att cgg ttt gag ggg agc gtc			1459
Pro Gly Ala Gly Ala Gly Gly Gly Glu Ile Arg Phe Glu Gly Ser Val			
440	445	450	
gac aag ctt aaa gac agc gac acc gtg act ggc ctc cat ttt aat gac			1507
Asp Lys Leu Lys Asp Ser Asp Thr Val Thr Gly Leu His Phe Asn Asp			
455	460	465	
cgg gcg tca ttg aag gaa tcc gtg cgt gcg ccg cat ggc gcc ctg gag			1555
Arg Ala Ser Leu Lys Glu Ser Val Arg Ala Pro His Gly Ala Leu Glu			
470	475	480	485
atc cgc ggg gcc gat cga aat aat ttg aac aat gtg gat gtc gat att			1603
Ile Arg Gly Ala Asp Arg Asn Asn Leu Asn Asn Val Asp Val Asp Ile			
490	495	500	
ccg ctc ggc gtg ttc acg gcg att tcc ggc gtt gca ggt tcg ggt aag			1651
Pro Leu Gly Val Phe Thr Ala Ile Ser Gly Val Ala Gly Ser Gly Lys			
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tcc tcg ttg att cat gag att ccg cgt gat gag tcg gtt gtg ttt gtc			1699
Ser Ser Leu Ile His Glu Ile Pro Arg Asp Glu Ser Val Val Phe Val			
520	525	530	
gat caa acc gca atc cac ggt tct aat cgt tcc aat cct gcg aca tat			1747
Asp Gln Thr Ala Ile His Gly Ser Asn Arg Ser Asn Pro Ala Thr Tyr			
535	540	545	
aca ggc atg ctg gat tcg att cgc aag gct ttt gcc aag gcc aat gat			1795
Thr Gly Met Leu Asp Ser Ile Arg Lys Ala Phe Ala Lys Ala Asn Asp			
550	555	560	565
gtg aaa ccg gcg ctg ttc tcc ccc aat tct gaa ggc gcg tgc cca aac			1843
Val Lys Pro Ala Leu Phe Ser Pro Asn Ser Glu Gly Ala Cys Pro Asn			
570	575	580	
tgt aag ggc gcc ggc tcg gtc tat gtc gat ttg ggc atg atg gct ggg			1891
Cys Lys Gly Ala Gly Ser Val Tyr Val Asp Leu Gly Met Met Ala Gly			
585	590	595	

gta tct tcg ccg tgt gag gtg tgc gag ggc aag cgt ttt gat gag tcc 1939  
 Val Ser Ser Pro Cys Glu Val Cys Glu Gly Lys Arg Phe Asp Glu Ser  
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 Val Leu Asp Tyr His Phe Gly Gly Lys Asp Ile Ala Asp Val Leu Gly  
 615 620 625

ctg tcg gct gcc aat gcg tat gag ttt ttc gcg gcg aaa gat tca aag 2035  
 Leu Ser Ala Ala Asn Ala Tyr Glu Phe Phe Ala Ala Lys Asp Ser Lys  
 630 635 640 645

att ttg cct gcg gca aag atc gca aag agg ctt gtc gac gtc ggc ctc 2083  
 Ile Leu Pro Ala Ala Lys Ile Ala Lys Arg Leu Val Asp Val Gly Leu  
 650 655 660

ggc tac atc acc ctc ggc cag ccg ctc acc acg ttg tcc ggc ggt gaa 2131  
 Gly Tyr Ile Thr Leu Gly Gln Pro Leu Thr Thr Leu Ser Gly Gly Glu  
 665 670 675

cgc cag cgt ttg aag ctc gcc acc cac atg gca gac aag gcc acc acc 2179  
 Arg Gln Arg Leu Lys Leu Ala Thr His Met Ala Asp Lys Ala Thr Thr  
 680 685 690

ttt att ttg gat gag ccc acc aca ggc ctg cac ctc gct gat gtg aaa 2227  
 Phe Ile Leu Asp Glu Pro Thr Thr Gly Leu His Leu Ala Asp Val Lys  
 695 700 705

acc ttg ctg gat ctt ttt gat caa ctg gtt gat gac ggc aag tct gtc 2275  
 Thr Leu Leu Asp Leu Phe Asp Gln Leu Val Asp Asp Gly Lys Ser Val  
 710 715 720 725

atc gtc atc gaa cac cac ctc ggc gtg ctc gct cac gct gac cac atc 2323  
 Ile Val Ile Glu His His Leu Gly Val Leu Ala His Ala Asp His Ile  
 730 735 740

att gat gtc ggc cct ggt gca ggt tct gat ggt ggc tcg att gta ttc 2371  
 Ile Asp Val Gly Pro Gly Ala Gly Ser Asp Gly Gly Ser Ile Val Phe  
 745 750 755

gag ggc agc ccc gcg gaa ctc atc aaa act gat act cca aca gga cgc 2419  
 Glu Gly Ser Pro Ala Glu Leu Ile Lys Thr Asp Thr Pro Thr Gly Arg  
 760 765 770

cac ctt aaa gct tat gta gat tagttttctta tggaaaaccc tgg 2463  
 His Leu Lys Ala Tyr Val Asp  
 775 780

&lt;210&gt; 146

&lt;211&gt; 780

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 146

Met Gln Lys Ala Asp Ser His Asp Trp Ile Ser Val His Gly Ala Asn

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Glu Asn Asn Leu Lys Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu	20	25	30
Thr Val Phe Thr Gly Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe	35	40	45
Gly Thr Ile Ala Ala Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser	50	55	60
Thr Phe Val Gln Gly Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp	65	70	75
His Leu Glu Gly Ile Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met	85	90	95
Gly Ala Asn Pro Arg Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala	100	105	110
Met Leu Arg Ile Leu Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly	115	120	125
Pro Gly Ala Tyr Ser Phe Asn Val Pro Ser Val Ser Ala Ser Gly Ala	130	135	140
Ile Thr Val Glu Lys Gly Gly Asn Thr Lys Arg Glu Lys Ala Thr Phe	145	150	155
Lys Arg Thr Gly Gly Met Cys Pro Ala Cys Glu Gly Met Gly Arg Ala	165	170	175
Ser Asp Ile Asp Leu Lys Glu Leu Phe Asp Ala Ser Leu Ser Leu Asn	180	185	190
Asp Gly Ala Leu Thr Ile Pro Gly Tyr Thr Pro Gly Gly Trp Ser Tyr	195	200	205
Arg Met Tyr Ser Glu Ser Gly Leu Phe Asp Ala Ala Lys Pro Ile Lys	210	215	220
Asp Phe Thr Glu Glu Glu Arg His Asn Phe Leu Tyr Leu Glu Pro Thr	225	230	235
Lys Met Lys Ile Ala Gly Ile Asn Met Thr Tyr Glu Gly Leu Ile Pro	245	250	255
Arg Ile Gln Lys Ser Met Leu Ser Lys Asp Arg Glu Gly Met Gln Lys	260	265	270
His Ile Arg Ala Phe Val Asp Arg Ala Val Thr Phe Ile Pro Cys Pro	275	280	285
Ala Cys Gly Gly Thr Arg Leu Ala Pro His Ala Leu Glu Ser Lys Ile	290	295	300
Asn Gly Lys Asn Ile Ala Glu Leu Cys Ala Met Glu Val Arg Asp Leu			

305		310		315		320
Ala Lys Trp Ile	Lys Thr Val Glu Ala	Pro Ser Val Ala	Pro Leu Leu			
	325	330	335			
Thr Ala Leu Thr	Glu Thr Leu Asp Asn Phe	Val Glu Ile Gly	Leu Gly			
	340	345	350			
Tyr Ile Gln Leu	Asp Arg Pro Ala Gly Thr	Leu Ser Gly Gly	Glu Ala			
	355	360	365			
Gln Arg Thr Lys	Met Ile Arg His Leu Gly	Ser Ala Leu Thr	Asp Val			
	370	375	380			
Thr Tyr Val Phe	Asp Glu Pro Thr Ala Gly	Leu His Ala Tyr	Asp Ile			
	385	390	395			400
Glu Arg Met Asn	Lys Leu Leu Leu Asp	Leu Arg Asp Lys	Gly Asn Thr			
	405	410	415			
Val Leu Val Val	Glu His Lys Pro Glu Thr	Ile Ala Ile Ala	Asp His			
	420	425	430			
Val Val Asp Leu	Gly Pro Gly Ala Gly Ala	Gly Gly Gly Glu	Ile Arg			
	435	440	445			
Phe Glu Gly Ser	Val Asp Lys Leu Lys Asp	Ser Asp Thr Val	Thr Gly			
	450	455	460			
Leu His Phe Asn	Asp Arg Ala Ser Leu Lys	Glu Ser Val Arg	Ala Pro			
	465	470	475			480
His Gly Ala Leu	Glu Ile Arg Gly Ala Asp	Arg Asn Asn Leu	Asn Asn			
	485	490	495			
Val Asp Val Asp	Ile Pro Leu Gly Val Phe	Thr Ala Ile Ser	Gly Val			
	500	505	510			
Ala Gly Ser Gly	Lys Ser Ser Leu Ile His	Glu Ile Pro Arg	Asp Glu			
	515	520	525			
Ser Val Val Phe	Val Asp Gln Thr Ala Ile His	Gly Ser Asn Arg	Ser			
	530	535	540			
Asn Pro Ala Thr	Tyr Thr Gly Met Leu Asp	Ser Ile Arg Lys	Ala Phe			
	545	550	555			560
Ala Lys Ala Asn	Asp Val Lys Pro Ala Leu	Phe Ser Pro Asn	Ser Glu			
	565	570	575			
Gly Ala Cys Pro	Asn Cys Lys Gly Ala Gly	Ser Val Tyr Val	Asp Leu			
	580	585	590			
Gly Met Met Ala	Gly Val Ser Ser Pro Cys	Glu Val Cys Glu	Gly Lys			
	595	600	605			
Arg Phe Asp Glu	Ser Val Leu Asp Tyr His	Phe Gly Gly Lys	Asp Ile			

610					615					620					
Ala 625	Asp	Val	Leu	Gly	Leu 630	Ser	Ala	Ala	Asn	Ala 635	Tyr	Glu	Phe	Phe	Ala 640
Ala	Lys	Asp	Ser	Lys 645	Ile	Leu	Pro	Ala	Ala 650	Lys	Ile	Ala	Lys	Arg 655	Leu
Val	Asp	Val	Gly 660	Leu	Gly	Tyr	Ile	Thr 665	Leu	Gly	Gln	Pro	Leu 670	Thr	Thr
Leu	Ser	Gly 675	Gly	Glu	Arg	Gln	Arg 680	Leu	Lys	Leu	Ala	Thr 685	His	Met	Ala
Asp 690	Lys	Ala	Thr	Thr	Phe	Ile 695	Leu	Asp	Glu	Pro	Thr 700	Thr	Gly	Leu	His
Leu 705	Ala	Asp	Val	Lys	Thr 710	Leu	Leu	Asp	Leu	Phe 715	Asp	Gln	Leu	Val	Asp 720
Asp	Gly	Lys	Ser	Val 725	Ile	Val	Ile	Glu	His 730	His	Leu	Gly	Val	Leu 735	Ala
His	Ala	Asp	His	Ile 740	Ile	Asp	Val	Gly 745	Pro	Gly	Ala	Gly	Ser 750	Asp	Gly
Gly	Ser	Ile 755	Val	Phe	Glu	Gly	Ser 760	Pro	Ala	Glu	Leu	Ile 765	Lys	Thr	Asp
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1				5					10					15		
ctg	gat	ctt	ttt	gat	caa	ctg	gtt	gat	gac	ggc	aag	tct	gtc	atc	gtc	96
Leu	Asp	Leu	Phe	Asp	Gln	Leu	Val	Asp	Asp	Gly	Lys	Ser	Val	Ile	Val	
			20					25					30			
atc	gaa	cac	cac	ctc	ggc	gtg	ctc	gct	cac	gct	gac	cac	atc	att	gat	144
Ile	Glu	His	His	Leu	Gly	Val	Leu	Ala	His	Ala	Asp	His	Ile	Ile	Asp	
		35					40					45				
gtc	ggc	cct	ggt	gca	ggt	tct	gat	ggt	ggc	tcg	att	gta	ttc	gag	ggc	192



Val Gly Pro Gly Ala Gly Ser Asp Gly Gly Ser Ile Val Phe Glu Gly  
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 Ser Pro Ala Glu Leu Ile Lys Thr Asp Thr Pro Thr Gly Arg His Leu  
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Ile Glu His His Leu Gly Val Leu Ala His Ala Asp His Ile Ile Asp  
 35 40 45

Val Gly Pro Gly Ala Gly Ser Asp Gly Gly Ser Ile Val Phe Glu Gly  
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 Met Gln Lys Ala Asp  
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tcc cat gat tgg att tcg gtc cac ggt gcg aat gaa aac aac ctc aaa 163  
 Ser His Asp Trp Ile Ser Val His Gly Ala Asn Glu Asn Asn Leu Lys  
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aat gtg tcg gtg cgc atc cct aaa agg cgt ctc acc gtg ttc acg ggt	211
Asn Val Ser Val Arg Ile Pro Lys Arg Arg Leu Thr Val Phe Thr Gly	
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Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe Gly Thr Ile Ala Ala	
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gaa tca cgc cgg ttg atc aac gaa acc tat agc act ttt gtg caa ggt	307
Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser Thr Phe Val Gln Gly	
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Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp His Leu Glu Gly Ile	
70 75 80 85	
acc acg gcg atc atc gtc gat cag gag cag atg ggc gca aac cca cgg	403
Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met Gly Ala Asn Pro Arg	
90 95 100	
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Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala Met Leu Arg Ile Leu	
105 110 115	
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Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly Pro Gly Ala Tyr Ser	
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Phe Asn Val Pro Ser Val Ser Ala Ser Gly Ala Ile Thr Val Glu Lys	
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Gly Gly Asn Thr Lys Arg Glu Lys Ala Thr Phe Lys Arg Thr Gly Gly	
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atg tgc cca gcg tgc gag ggc atg ggc agg gcc tca gac atc gac ctc	643
Met Cys Pro Ala Cys Glu Gly Met Gly Arg Ala Ser Asp Ile Asp Leu	
170 175 180	
aaa gag ctt ttc gac gcc tcc ctc tcc ctc aac gac ggc gcc ctg acc	691
Lys Glu Leu Phe Asp Ala Ser Leu Ser Leu Asn Asp Gly Ala Leu Thr	
185 190 195	
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Ile Pro Gly Tyr Thr Pro Gly Gly Trp Ser Tyr Arg Met Tyr Ser Glu	
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Gly Ile Asn Met Thr Tyr Glu Gly Leu Ile Pro Arg Ile Gln Lys Ser	
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Val Asp Arg Ala Val Thr Phe Ile Pro Cys Pro Ala Cys Gly Gly Thr	
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Arg Leu Ala Pro His Ala Leu Glu Ser Lys Ile Asn Gly Lys Asn Ile	
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gct gag ttg tgc gcg atg gag gtc cgt gat ttg gcc aag tgg atc aaa	1075
Ala Glu Leu Cys Ala Met Glu Val Arg Asp Leu Ala Lys Trp Ile Lys	
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Thr Val Glu Ala Pro Ser Val Ala Pro Leu Leu Thr Ala Leu Thr Glu	
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Thr Leu Asp Asn Phe Val Glu Ile Gly Leu Gly Tyr Ile Gln Leu Asp	
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Arg Pro Ala Gly Thr Leu Ser Gly Gly Glu Ala Gln Arg Thr Lys Met	
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Ile Arg His Leu Gly Ser Ala Leu Thr Asp Val Thr Tyr Val Phe Asp	
375 380 385	
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Glu Pro Thr Ala Gly Leu His Ala Tyr Asp Ile Glu Arg Met Asn Lys	
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Leu Leu Leu Asp Leu Arg Asp Lys Gly Asn Thr Val Leu Val Val Glu	
410 415 420	
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His Lys Pro Glu Thr Ile Ala Ile Ala Asp His Val Val Asp Leu Gly	
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Pro Gly Ala Gly Ala Gly Gly Gly Glu Ile Arg Phe Glu Gly Ser Val	
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gac aag ctt aaa gac agc gac acc gtg act ggc ctc cat ttt aat gac	1507
Asp Lys Leu Lys Asp Ser Asp Thr Val Thr Gly Leu His Phe Asn Asp	
455 460 465	
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Arg Ala Ser Leu Lys Glu Ser Val Arg Ala Pro His Gly Ala Leu Glu  
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 Thr Val Phe Thr Gly Val Ser Gly Ser Gly Lys Ser Ser Leu Val Phe  
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 Gly Thr Ile Ala Ala Glu Ser Arg Arg Leu Ile Asn Glu Thr Tyr Ser  
 50 55 60  
 Thr Phe Val Gln Gly Phe Met Pro Ser Met Ala Arg Pro Asp Val Asp  
 65 70 75 80  
 His Leu Glu Gly Ile Thr Thr Ala Ile Ile Val Asp Gln Glu Gln Met  
 85 90 95  
 Gly Ala Asn Pro Arg Ser Thr Val Gly Thr Ala Thr Asp Ala Thr Ala  
 100 105 110  
 Met Leu Arg Ile Leu Phe Ser Arg Ile Ala Glu Pro Asn Ala Gly Gly  
 115 120 125  
 Pro Gly Ala Tyr Ser Phe Asn Val Pro Ser Val Ser Ala Ser Gly Ala  
 130 135 140  
 Ile Thr Val Glu Lys Gly Gly Asn Thr Lys Arg Glu Lys Ala Thr Phe  
 145 150 155 160  
 Lys Arg Thr Gly Gly Met Cys Pro Ala Cys Glu Gly Met Gly Arg Ala  
 165 170 175  
 Ser Asp Ile Asp Leu Lys Glu Leu Phe Asp Ala Ser Leu Ser Leu Asn  
 180 185 190

Asp Gly Ala Leu Thr Ile Pro Gly Tyr Thr Pro Gly Gly Trp Ser Tyr  
 195 200 205  
 Arg Met Tyr Ser Glu Ser Gly Leu Phe Asp Ala Ala Lys Pro Ile Lys  
 210 215 220  
 Asp Phe Thr Glu Glu Glu Arg His Asn Phe Leu Tyr Leu Glu Pro Thr  
 225 230 235 240  
 Lys Met Lys Ile Ala Gly Ile Asn Met Thr Tyr Glu Gly Leu Ile Pro  
 245 250 255  
 Arg Ile Gln Lys Ser Met Leu Ser Lys Asp Arg Glu Gly Met Gln Lys  
 260 265 270  
 His Ile Arg Ala Phe Val Asp Arg Ala Val Thr Phe Ile Pro Cys Pro  
 275 280 285  
 Ala Cys Gly Gly Thr Arg Leu Ala Pro His Ala Leu Glu Ser Lys Ile  
 290 295 300  
 Asn Gly Lys Asn Ile Ala Glu Leu Cys Ala Met Glu Val Arg Asp Leu  
 305 310 315 320  
 Ala Lys Trp Ile Lys Thr Val Glu Ala Pro Ser Val Ala Pro Leu Leu  
 325 330 335  
 Thr Ala Leu Thr Glu Thr Leu Asp Asn Phe Val Glu Ile Gly Leu Gly  
 340 345 350  
 Tyr Ile Gln Leu Asp Arg Pro Ala Gly Thr Leu Ser Gly Gly Glu Ala  
 355 360 365  
 Gln Arg Thr Lys Met Ile Arg His Leu Gly Ser Ala Leu Thr Asp Val  
 370 375 380  
 Thr Tyr Val Phe Asp Glu Pro Thr Ala Gly Leu His Ala Tyr Asp Ile  
 385 390 395 400  
 Glu Arg Met Asn Lys Leu Leu Leu Asp Leu Arg Asp Lys Gly Asn Thr  
 405 410 415  
 Val Leu Val Val Glu His Lys Pro Glu Thr Ile Ala Ile Ala Asp His  
 420 425 430  
 Val Val Asp Leu Gly Pro Gly Ala Gly Ala Gly Gly Gly Glu Ile Arg  
 435 440 445  
 Phe Glu Gly Ser Val Asp Lys Leu Lys Asp Ser Asp Thr Val Thr Gly  
 450 455 460  
 Leu His Phe Asn Asp Arg Ala Ser Leu Lys Glu Ser Val Arg Ala Pro  
 465 470 475 480  
 His Gly Ala Leu Glu Ile Arg Gly Ala Asp Arg Asn Asn Leu Asn Asn  
 485 490 495

Val Asp Val Asp Ile Pro Leu Gly Val Phe Thr Ala Ile Ser Gly Val  
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Ala Gly Ser Gly Lys Ser Ser Leu Ile  
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<211> 864

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(841)

<223> RXA00995

<400> 151

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                                         Met Asn Pro His Tyr
                                         1 5

ctg ctt gcc acg gtc aaa cga gtc ctg ctg cag ctg aaa gcc gat aaa 163
Leu Leu Ala Thr Val Lys Arg Val Leu Leu Gln Leu Lys Ala Asp Lys
                        10 15 20

cgt tcc atc gcg ctg att ctt cta gca ccc gtg gcg ttg atg tcg ctg 211
Arg Ser Ile Ala Leu Ile Leu Leu Ala Pro Val Ala Leu Met Ser Leu
                        25 30 35

ttt tat tac atg tat tcc tcc aca ccg gca ggc acc cag ctg ttt aag 259
Phe Tyr Tyr Met Tyr Ser Ser Thr Pro Ala Gly Thr Gln Leu Phe Lys
                        40 45 50

acc att tcc acg gtc atg atc gca gtg ttc ccc ttg atg ctc atg ttt 307
Thr Ile Ser Thr Val Met Ile Ala Val Phe Pro Leu Met Leu Met Phe
                        55 60 65

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Leu Met Thr Ser Val Thr Met Gln Arg Glu Arg Asn Ala Gly Thr Leu
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Glu Arg Leu Trp Thr Thr Asn Ile His Arg Val Asp Leu Ile Gly Gly
                        90 95 100

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Tyr Gly Val Ala Phe Gly Ile Met Ala Val Ala Gln Ser Leu Leu Met
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gtg ctc acc ctt cgg tat ctc ctg ggt gtg gaa acc gaa tcg gag tgg 499
Val Leu Thr Leu Arg Tyr Leu Leu Gly Val Glu Thr Glu Ser Glu Trp
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 Trp Ile Ser Thr Leu Ile Ala Ala Ile Thr Gly Leu Ile Gly Val Ser  
 135 140 145

ctt ggc ctg ttg agc tct gcg ttt gcc agc act gag ttc caa gct atc 595  
 Leu Gly Leu Leu Ser Ser Ala Phe Ala Ser Thr Glu Phe Gln Ala Ile  
 150 155 160 165

caa acg ctg ccg ttg ctt att ttg ccc cag ttc cta ttg tgc ggt ttg 643  
 Gln Thr Leu Pro Leu Leu Ile Leu Pro Gln Phe Leu Leu Cys Gly Leu  
 170 175-- 180

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gtg ttg ccg ctg tcc tat gca gtt gat gca gcg ctt gag gcc tca cgg 739  
 Val Leu Pro Leu Ser Tyr Ala Val Asp Ala Ala Leu Glu Ala Ser Arg  
 200 205 210

acg gga atc gga cag caa gta gtg gtc aac att gcc atc tgc gcc gcg 787  
 Thr Gly Ile Gly Gln Gln Val Val Val Asn Ile Ala Ile Cys Ala Ala  
 215 220 225

ttt gcc gtg agc ttc ctg ctg gtg gcg gcg cta tcg atg ccg aga atg 835  
 Phe Ala Val Ser Phe Leu Leu Val Ala Ala Leu Ser Met Pro Arg Met  
 230 235 240 245

acc cgc tagattactc ttccagcgcgag gtg 864  
 Thr Arg

&lt;210&gt; 152

&lt;211&gt; 247

&lt;212&gt; PRT

<213> *Corynebacterium glutamicum*

&lt;400&gt; 152

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Leu Lys Ala Asp Lys Arg Ser Ile Ala Leu Ile Leu Leu Ala Pro Val  
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Ala Leu Met Ser Leu Phe Tyr Tyr Met Tyr Ser Ser Thr Pro Ala Gly  
 35 40 45

Thr Gln Leu Phe Lys Thr Ile Ser Thr Val Met Ile Ala Val Phe Pro  
 50 55 60

Leu Met Leu Met Phe Leu Met Thr Ser Val Thr Met Gln Arg Glu Arg  
 65 70 75 80

Asn Ala Gly Thr Leu Glu Arg Leu Trp Thr Thr Asn Ile His Arg Val  
 85 90 95

Asp Leu Ile Gly Gly Tyr Gly Val Ala Phe Gly Ile Met Ala Val Ala  
 100 105 110  
 Gln Ser Leu Leu Met Val Leu Thr Leu Arg Tyr Leu Leu Gly Val Glu  
 115 120 125  
 Thr Glu Ser Glu Trp Trp Ile Ser Thr Leu Ile Ala Ala Ile Thr Gly  
 130 135 140  
 Leu Ile Gly Val Ser Leu Gly Leu Leu Ser Ser Ala Phe Ala Ser Thr  
 145 150 155 160  
 Glu Phe Gln Ala Ile Gln Thr Leu Pro Leu Leu Ile Leu Pro Gln Phe  
 165 170 175  
 Leu Leu Cys Gly Leu Leu Ile Pro Arg Asp Asp Leu Pro Asp Val Leu  
 180 185 190  
 Arg Trp Val Ser Asn Val Leu Pro Leu Ser Tyr Ala Val Asp Ala Ala  
 195 200 205  
 Leu Glu Ala Ser Arg Thr Gly Ile Gly Gln Gln Val Val Val Asn Ile  
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 Ala Ile Cys Ala Ala Phe Ala Val Ser Phe Leu Leu Val Ala Ala Leu  
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 Ser Met Pro Arg Met Thr Arg  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 Met Gly Val Ser Ala  
 1 5  
 ctt aac atg tct gac atg gtg gcg aac aaa cgg gca cag cgt aaa gtc 163  
 Leu Asn Met Ser Asp Met Val Ala Asn Lys Arg Ala Gln Arg Lys Val  
 10 15 20  
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 Trp Leu Ala Val Ala Leu Ser Val Phe Thr Val Ala Trp Gly Gly Asn  
 25 30 35  
 gaa ttc act ccc ttg ctg gtg ttt tac cga ggt gaa ggg ttc ttt agc 259

Glu	Phe	Thr	Pro	Leu	Leu	Val	Phe	Tyr	Arg	Gly	Glu	Gly	Phe	Phe	Ser		
		40					45					50					
aac	ctg	ttc	atc	gac	ctt	ttg	ctg	gtg	ttt	tat	gcc	atc	gga	gta	gcg	307	
Asn	Leu	Phe	Ile	Asp	Leu	Leu	Leu	Val	Phe	Tyr	Ala	Ile	Gly	Val	Ala		
	55				60						65						
gta	ggt	ttg	ctg	gca	gct	ggt	cct	tta	tct	gac	cgc	tat	ggc	cga	cgt	355	
Val	Gly	Leu	Leu	Ala	Ala	Gly	Pro	Leu	Ser	Asp	Arg	Tyr	Gly	Arg	Arg		
	70				75					80					85		
gcc	gtc	atg	ttg	cct	gcg	cca	ttg	atc	gcg	atc	ttg	ggt	tcc	gcg	ttg	403	
Ala	Val	Met	Leu	Pro	Ala	Pro	Leu	Ile	Ala	Ile	Leu	Gly	Ser	Ala	Leu		
				90					95					100			
att	gcc	tcg	ggt	gaa	gaa	acc	gcc	atc	ctg	att	gcc	att	ggt	cga	gtg	451	
Ile	Ala	Ser	Gly	Glu	Glu	Thr	Ala	Ile	Leu	Ile	Ala	Ile	Gly	Arg	Val		
		105						110					115				
ctg	tcg	gga	att	tcg	gtg	ggc	atg	gtg	atg	aca	gcg	gga	ggt	tcc	tgg	499	
Leu	Ser	Gly	Ile	Ser	Val	Gly	Met	Val	Met	Thr	Ala	Gly	Gly	Ser	Trp		
	120					125						130					
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Ile	Lys	Glu	Leu	Ser	Ser	Ser	Arg	Phe	Glu	Pro	Gly	Val	Lys	Thr	Ser		
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gct	ggt	gca	aaa	cgc	gca	tcg	atg	tct	ttg	acc	ggt	ggt	ttt	gcg	ctc	595	
Ala	Gly	Ala	Lys	Arg	Ala	Ser	Met	Ser	Leu	Thr	Gly	Gly	Phe	Ala	Leu		
	150				155					160					165		
ggc	cca	gcg	ctt	gct	ggt	gtg	atg	gca	cag	tgg	ctg	cca	cta	cct	gga	643	
Gly	Pro	Ala	Leu	Ala	Gly	Val	Met	Ala	Gln	Trp	Leu	Pro	Leu	Pro	Gly		
			170					175						180			
cag	ttg	gca	tat	gtt	ttg	cac	att	att	ctc	act	ctg	att	ttg	ttc	ccg	691	
Gln	Leu	Ala	Tyr	Val	Leu	His	Ile	Ile	Leu	Thr	Leu	Ile	Leu	Phe	Pro		
		185						190					195				
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Leu	Leu	Ile	Thr	Ala	Pro	Glu	Thr	Arg	Gln	Ser	Ala	His	Leu	Lys	Thr		
		200					205					210					
aag	gga	tca	ttc	tgg	tca	gat	gtg	ctt	gtg	cca	tct	gca	cta	gac	aag	787	
Lys	Gly	Ser	Phe	Trp	Ser	Asp	Val	Leu	Val	Pro	Ser	Ala	Leu	Asp	Lys		
	215					220					225						
cga	ttc	ttg	ttt	gtg	gtt	gct	cca	att	gga	ccg	tgg	gtt	ttc	ggt	gcg	835	
Arg	Phe	Leu	Phe	Val	Val	Ala	Pro	Ile	Gly	Pro	Trp	Val	Phe	Gly	Ala		
	230				235					240					245		
gcc	ttc	act	gcc	tac	gca	gtt	ttg	ccg	tcg	cag	ctg	cgt	gac	atg	gtt	883	
Ala	Phe	Thr	Ala	Tyr	Ala	Val	Leu	Pro	Ser	Gln	Leu	Arg	Asp	Met	Val		
			250						255				260				
tct	gca	ccc	gtt	gcg	tat	tct	gcg	ctg	atc	gct	ttg	gtt	acc	tta	ggt	931	
Ser	Ala	Pro	Val	Ala	Tyr	Ser	Ala	Leu	Ile	Ala	Leu	Val	Thr	Leu	Gly		

265	270	275	
tct gga ttt ggt atc caa caa ttc ggt cct caa atc atg ggc acc tct			979
Ser Gly Phe Gly Ile Gln Gln Phe Gly Pro Gln Ile Met Gly Thr Ser			
280	285	290	
aaa act cgc ggg ccg att ttg gcc atg ttc gtc aca gtc atc ggc atg			1027
Lys Thr Arg Gly Pro Ile Leu Ala Met Phe Val Thr Val Ile Gly Met			
295	300	305	
atc ggc gcg gtg atc gtg gtg atg aac cct cat cca tgg tgg gcg cta			1075
Ile Gly Ala Val Ile Val Val Met Asn Pro His Pro Trp Trp Ala Leu			
310	315	320	325
gtt ggc tgc atg gcc ctc ggc ctg tct tat ggc ctg tgt atg ttc atg			1123
Val Gly Cys Met Ala Leu Gly Leu Ser Tyr Gly Leu Cys Met Phe Met			
330	335	340	
ggg ttg gcg gaa act caa aac att gct cca cct att gat atg gca ggc			1171
Gly Leu Ala Glu Thr Gln Asn Ile Ala Pro Pro Ile Asp Met Ala Gly			
345	350	355	
ctg acg ggt att ttc tac tgc ctg acg tac gta ggt atg gtc ttt cca			1219
Leu Thr Gly Ile Phe Tyr Cys Leu Thr Tyr Val Gly Met Val Phe Pro			
360	365	370	
gcc ttg atg acc tgg ttg aat caa tgg ctc agt tac ccg ttc atg ctg			1267
Ala Leu Met Thr Trp Leu Asn Gln Trp Leu Ser Tyr Pro Phe Met Leu			
375	380	385	
ggc ttt ggt gcg gtg atg gca act att tgt ctg atc att gtg agt ttt			1315
Gly Phe Gly Ala Val Met Ala Thr Ile Cys Leu Ile Ile Val Ser Phe			
390	395	400	405
agt gca cgc cga ttc tgagaaacaa ctaaagtgag cca			1353
Ser Ala Arg Arg Phe			
410			

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 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 154  
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 Ala Trp Gly Gly Asn Glu Phe Thr Pro Leu Leu Val Phe Tyr Arg Gly  
 35 40 45  
 Glu Gly Phe Phe Ser Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr  
 50 55 60

Ala Ile Gly Val Ala Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp  
 65 70 75 80  
 Arg Tyr Gly Arg Arg Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile  
 85 90 95  
 Leu Gly Ser Ala Leu Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile  
 100 105 110  
 Ala Ile Gly Arg Val Leu Ser Gly Ile Ser Val Gly Met Val Met Thr  
 115 120 125  
 Ala Gly Gly Ser Trp Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro  
 130 135 140  
 Gly Val Lys Thr Ser Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr  
 145 150 155 160  
 Gly Gly Phe Ala Leu Gly Pro Ala Leu Ala Gly Val Met Ala Gln Trp  
 165 170 175  
 Leu Pro Leu Pro Gly Gln Leu Ala Tyr Val Leu His Ile Ile Leu Thr  
 180 185 190  
 Leu Ile Leu Phe Pro Leu Leu Ile Thr Ala Pro Glu Thr Arg Gln Ser  
 195 200 205  
 Ala His Leu Lys Thr Lys Gly Ser Phe Trp Ser Asp Val Leu Val Pro  
 210 215 220  
 Ser Ala Leu Asp Lys Arg Phe Leu Phe Val Val Ala Pro Ile Gly Pro  
 225 230 235 240  
 Trp Val Phe Gly Ala Ala Phe Thr Ala Tyr Ala Val Leu Pro Ser Gln  
 245 250 255  
 Leu Arg Asp Met Val Ser Ala Pro Val Ala Tyr Ser Ala Leu Ile Ala  
 260 265 270  
 Leu Val Thr Leu Gly Ser Gly Phe Gly Ile Gln Gln Phe Gly Pro Gln  
 275 280 285  
 Ile Met Gly Thr Ser Lys Thr Arg Gly Pro Ile Leu Ala Met Phe Val  
 290 295 300  
 Thr Val Ile Gly Met Ile Gly Ala Val Ile Val Val Met Asn Pro His  
 305 310 315 320  
 Pro Trp Trp Ala Leu Val Gly Cys Met Ala Leu Gly Leu Ser Tyr Gly  
 325 330 335  
 Leu Cys Met Phe Met Gly Leu Ala Glu Thr Gln Asn Ile Ala Pro Pro  
 340 345 350  
 Ile Asp Met Ala Gly Leu Thr Gly Ile Phe Tyr Cys Leu Thr Tyr Val  
 355 360 365

Gly Met Val Phe Pro Ala Leu Met Thr Trp Leu Asn Gln Trp Leu Ser  
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Tyr Pro Phe Met Leu Gly Phe Gly Ala Val Met Ala Thr Ile Cys Leu  
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Ile Ile Val Ser Phe Ser Ala Arg Arg Phe  
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<211> 703

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(703)

<223> FRXA00803

<400> 155

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cggccggttct gttaaagatt ggtctggcca tttcctccat atg ggg gtg tcc gcg 115  
 Met Gly Val Ser Ala  
 1 5

ctt aac atg tct gac atg gtg gcg aac aaa cgg gca cag cgt aaa gtc 163  
 Leu Asn Met Ser Asp Met Val Ala Asn Lys Arg Ala Gln Arg Lys Val  
 10 15 20

tgg cta gcg gta gct tta tcg gtc ttt acg gtc gcg tgg ggt ggc aat 211  
 Trp Leu Ala Val Ala Leu Ser Val Phe Thr Val Ala Trp Gly Gly Asn  
 25 30 35

gaa ttc act ccc ttg ctg gtg ttt tac cga ggt gaa ggg ttc ttt agc 259  
 Glu Phe Thr Pro Leu Leu Val Phe Tyr Arg Gly Glu Gly Phe Phe Ser  
 40 45 50

aac ctg ttc atc gac ctt ttg ctg gtg ttt tat gcc atc gga gta gcg 307  
 Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr Ala Ile Gly Val Ala  
 55 60 65

gta ggt ttg ctg gca gct ggt cct tta tct gac cgc tat ggc cga cgt 355  
 Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp Arg Tyr Gly Arg Arg  
 70 75 80 85

gcc gtc atg ttg cct gcg cca ttg atc gcg atc ttg ggt tcc gcg ttg 403  
 Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile Leu Gly Ser Ala Leu  
 90 95 100

att gcc tcg ggt gaa gaa acc gcc atc ctg att gcc att ggt cga gtg 451  
 Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile Ala Ile Gly Arg Val  
 105 110 115

ctg tcg gga att tcg gtg ggc atg gtg atg aca gcg gga ggt tcc tgg 499  
 Leu Ser Gly Ile Ser Val Gly Met Val Met Thr Ala Gly Gly Ser Trp



120	125	130	
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Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro Gly Val Lys Thr Ser			
135	140	145	
gct ggt gca aaa cgc gca tcg atg tct ttg acc ggt ggt ttt gcg ctc			595
Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr Gly Gly Phe Ala Leu			
150	155	160	165
ggc cca gcg ctt gct ggt gtg atg gca cag tgg ctg cca caa cct gga			643
Gly Pro Ala Leu Ala Gly Val Met Ala Gln Trp Leu Pro Gln Pro Gly			
	170	175	180
cag ttg gca tat gtt ttg cac att att ctc act ctg att ttg ttc ccg			691
Gln Leu Ala Tyr Val Leu His Ile Ile Leu Thr Leu Ile Leu Phe Pro			
	185	190	195
ttg ctt att aca			703
Leu Leu Ile Thr			
200			

&lt;210&gt; 156

&lt;211&gt; 201

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 156

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Ala Gln Arg Lys Val Trp Leu Ala Val Ala Leu Ser Val Phe Thr Val			
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Ala Trp Gly Gly Asn Glu Phe Thr Pro Leu Leu Val Phe Tyr Arg Gly			
	35	40	45
Glu Gly Phe Phe Ser Asn Leu Phe Ile Asp Leu Leu Leu Val Phe Tyr			
	50	55	60
Ala Ile Gly Val Ala Val Gly Leu Leu Ala Ala Gly Pro Leu Ser Asp			
	65	70	75
Arg Tyr Gly Arg Arg Ala Val Met Leu Pro Ala Pro Leu Ile Ala Ile			
	85	90	95
Leu Gly Ser Ala Leu Ile Ala Ser Gly Glu Glu Thr Ala Ile Leu Ile			
	100	105	110
Ala Ile Gly Arg Val Leu Ser Gly Ile Ser Val Gly Met Val Met Thr			
	115	120	125
Ala Gly Gly Ser Trp Ile Lys Glu Leu Ser Ser Ser Arg Phe Glu Pro			
	130	135	140
Gly Val Lys Thr Ser Ala Gly Ala Lys Arg Ala Ser Met Ser Leu Thr			

145	150	155	160
Gly Gly Phe Ala Leu Gly Pro Ala Leu Ala Gly Val Met Ala Gln Trp			
	165	170	175
Leu Pro Gln Pro Gly Gln Leu Ala Tyr Val Leu His Ile Ile Leu Thr			
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Leu Ile Leu Phe Pro Leu Leu Ile Thr			
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<220>  
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 <222> (101)..(991)  
 <223> RXA01407

<400> 157  
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 Leu Gln Asp Thr Ile  
 1 5  
 ggt tgc cga tgg atc ttc ctc ctc aac gtg ccc tta gga atc atc gcg 163  
 Gly Cys Arg Trp Ile Phe Leu Leu Asn Val Pro Leu Gly Ile Ile Ala  
 10 15 20  
 atc atg gct gga cta ttc atc cag ccc aag aac acg gcc gtg aat gtg 211  
 Ile Met Ala Gly Leu Phe Ile Gln Pro Lys Asn Thr Ala Val Asn Val  
 25 30 35  
 aag cga ttt gat cgg cca ggt ttc ctc ggc gca atg ctg gtg atg gtg 259  
 Lys Arg Phe Asp Arg Pro Gly Phe Leu Gly Ala Met Leu Val Met Val  
 40 45 50  
 gcg caa gcc gtg att gcg gag tta att tgc agc aga agt ccg gcc gca 307  
 Ala Gln Ala Val Ile Ala Glu Leu Ile Cys Ser Arg Ser Pro Ala Ala  
 55 60 65  
 ctt act atc tgt gca tgc ctc gtc tta agt gct gcg gtg gta tgc ggt 355  
 Leu Thr Ile Cys Ala Cys Leu Val Leu Ser Ala Ala Val Val Cys Gly  
 70 75 80 85  
 ttt gta gtg cgc tgg ctg cga gtt cca ggc cga ctt ttt gat ctc agc 403  
 Phe Val Val Arg Trp Leu Arg Val Pro Gly Arg Leu Phe Asp Leu Ser  
 90 95 100  
 atc atg cgc atc cca ggt ttc cga gtg ggt aat tcc tcc gga agt atc 451  
 Ile Met Arg Ile Pro Gly Phe Arg Val Gly Asn Ser Ser Gly Ser Ile  
 105 110 115

tac cgc ttg gta atc acc gca gca cca ttc atg ttc act ttg ctg ttc 499  
 Tyr Arg Leu Val Ile Thr Ala Ala Pro Phe Met Phe Thr Leu Leu Phe  
 120 125 130

caa gtg gcg ttt ggg tgg tct gca aca tta gcg ggt gcc atg gtg gtc 547  
 Gln Val Ala Phe Gly Trp Ser Ala Thr Leu Ala Gly Ala Met Val Val  
 135 140 145

gca cta ttc gca ggc aac gtg gca atc aaa cct ttc acc acg ccg atc 595  
 Ala Leu Phe Ala Gly Asn Val Ala Ile Lys Pro Phe Thr Thr Pro Ile  
 150 155 160 165

att aaa cgc tgg aat ttc aaa cca gta ctg gtc ttt tct aac gct gct 643  
 Ile Lys Arg Trp Asn Phe Lys Pro Val Leu Val Phe Ser Asn Ala Ala  
 170 175 180

ggc gcc ttg gta ttg gca act ttt ttg ttc gtt cgt gca gat acc cca 691  
 Gly Ala Leu Val Leu Ala Thr Phe Leu Phe Val Arg Ala Asp Thr Pro  
 185 190 195

ctg gtt ctg atc gtg ctg ctg ctg ttt gtt tcg ggc gca tta agg tcc 739  
 Leu Val Leu Ile Val Leu Leu Leu Phe Val Ser Gly Ala Leu Arg Ser  
 200 205 210

ctg ggt ttc agc gcc tac aac acc ttg cag ttt gtc gat atc tca cca 787  
 Leu Gly Phe Ser Ala Tyr Asn Thr Leu Gln Phe Val Asp Ile Ser Pro  
 215 220 225

gaa caa acc agc aac gcc aac gtg tta tca gca acc ctg cac caa cta 835  
 Glu Gln Thr Ser Asn Ala Asn Val Leu Ser Ala Thr Leu His Gln Leu  
 230 235 240 245

ggc atg tct ttg ggt att gcg gta gca gtc atc gcc atg tcc ctt gca 883  
 Gly Met Ser Leu Gly Ile Ala Val Ala Val Ile Ala Met Ser Leu Ala  
 250 255 260

ccc acc gcc aac tgg gca ttc cca ctg gca gca gcg ttg ttc ctg att 931  
 Pro Thr Ala Asn Trp Ala Phe Pro Leu Ala Ala Ala Leu Phe Leu Ile  
 265 270 275

cct cta atc ggc gca cta tct ttg cct cgc gac ggc ggt gcc cga gcc 979  
 Pro Leu Ile Gly Ala Leu Ser Leu Pro Arg Asp Gly Gly Ala Arg Ala  
 280 285 290

ttt tcc tcc tct tagaaaccca cttctgaaag gta 1014  
 Phe Ser Ser Ser  
 295

<210> 158  
 <211> 297  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 158  
 Leu Gln Asp Thr Ile Gly Cys Arg Trp Ile Phe Leu Leu Asn Val Pro  
 1 5 10 15

Leu Gly Ile Ile Ala Ile Met Ala Gly Leu Phe Ile Gln Pro Lys Asn  
 20 25 30  
 Thr Ala Val Asn Val Lys Arg Phe Asp Arg Pro Gly Phe Leu Gly Ala  
 35 40 45  
 Met Leu Val Met Val Ala Gln Ala Val Ile Ala Glu Leu Ile Cys Ser  
 50 55 60  
 Arg Ser Pro Ala Ala Leu Thr Ile Cys Ala Cys Leu Val Leu Ser Ala  
 65 70 75 80  
 Ala Val Val Cys Gly Phe Val Val Arg Trp Leu Arg Val Pro Gly Arg  
 85 90 95  
 Leu Phe Asp Leu Ser Ile Met Arg Ile Pro Gly Phe Arg Val Gly Asn  
 100 105 110  
 Ser Ser Gly Ser Ile Tyr Arg Leu Val Ile Thr Ala Ala Pro Phe Met  
 115 120 125  
 Phe Thr Leu Leu Phe Gln Val Ala Phe Gly Trp Ser Ala Thr Leu Ala  
 130 135 140  
 Gly Ala Met Val Val Ala Leu Phe Ala Gly Asn Val Ala Ile Lys Pro  
 145 150 155 160  
 Phe Thr Thr Pro Ile Ile Lys Arg Trp Asn Phe Lys Pro Val Leu Val  
 165 170 175  
 Phe Ser Asn Ala Ala Gly Ala Leu Val Leu Ala Thr Phe Leu Phe Val  
 180 185 190  
 Arg Ala Asp Thr Pro Leu Val Leu Ile Val Leu Leu Leu Phe Val Ser  
 195 200 205  
 Gly Ala Leu Arg Ser Leu Gly Phe Ser Ala Tyr Asn Thr Leu Gln Phe  
 210 215 220  
 Val Asp Ile Ser Pro Glu Gln Thr Ser Asn Ala Asn Val Leu Ser Ala  
 225 230 235 240  
 Thr Leu His Gln Leu Gly Met Ser Leu Gly Ile Ala Val Ala Val Ile  
 245 250 255  
 Ala Met Ser Leu Ala Pro Thr Ala Asn Trp Ala Phe Pro Leu Ala Ala  
 260 265 270  
 Ala Leu Phe Leu Ile Pro Leu Ile Gly Ala Leu Ser Leu Pro Arg Asp  
 275 280 285  
 Gly Gly Ala Arg Ala Phe Ser Ser Ser  
 290 295

&lt;210&gt; 159

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<211> 324
<212> DNA
<213> Corynebacterium glutamicum
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<220>  
<221> CDS  
<222> (101)..(301)  
<223> RXA01408
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<400> 159
cgcatagagt tatctcga aa ctaccaagac ggtttctttt ctttagatct aaggaggaga 60

gaccgtcttt caccctttca tctgattgga catcgacgcc atg cgc aat gat cgg      115
                                   Met Arg Asn Asp Arg
                                   1                               5

tcc ttt agc gtt ccc att gcg cta ctt gcc gcg gga gca ctg ttt cta      163
Ser Phe Ser Val Pro Ile Ala Leu Leu Ala Ala Gly Ala Leu Phe Leu
                        10                                15                                20

gaa atc ctc gac ggc acc atc ctg aca acc gca gtg cca gct att gct      211
Glu Ile Leu Asp Gly Thr Ile Leu Thr Thr Ala Val Pro Ala Ile Ala
                        25                                30                                35

cgt gac ttc ggt att gac gcc gtg gat gtc agc att gca ctg gtt gct      259
Arg Asp Phe Gly Ile Asp Ala Val Asp Val Ser Ile Ala Leu Val Ala
                        40                                45                                50

tac ttg gca gcc gca gca gct ggc att ccg ctg cag ggt ggc              301
Tyr Leu Ala Ala Ala Ala Ala Gly Ile Pro Leu Gln Gly Gly
                    55                                60                                65

tagcggatcg atttggtgtg cgc                                           324
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<210> 160
<211> 67
<212> PRT
<213> Corynebacterium glutamicum
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<400> 160
Met  Arg  Asn  Asp  Arg  Ser  Phe  Ser  Val  Pro  Ile  Ala  Leu  Leu  Ala  Ala
  1              5              10              15

Gly  Ala  Leu  Phe  Leu  Glu  Ile  Leu  Asp  Gly  Thr  Ile  Leu  Thr  Thr  Ala
          20              25              30

Val  Pro  Ala  Ile  Ala  Arg  Asp  Phe  Gly  Ile  Asp  Ala  Val  Asp  Val  Ser
          35              40              45

Ile  Ala  Leu  Val  Ala  Tyr  Leu  Ala  Ala  Ala  Ala  Ala  Gly  Ile  Pro  Leu
  50              55              60

Gln  Gly  Gly
  65

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<210> 161  
 <211> 1275  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1252)  
 <223> RXN01922

<400> 161

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acactccttt ggtcacctgg tttggttgag ggaaacagac cgccaagaa cccaagaaat 60

ccaagaaaa catgctgctt atgaattaaa gtgagcaccc atg aga tca gga aac 115
                                   Met Arg Ser Gly Asn
                                   1                               5

gcc aat cgc gtc ttc ata ggt gtt acc atc ctg ctg ttt act gca gga 163
Ala Asn Arg Val Phe Ile Gly Val Thr Ile Leu Leu Phe Thr Ala Gly
                                   10                               15                               20

tgg gca gcc aat cat ttc gcg tca gtg ttg gtg ttg atc cgt gaa caa 211
Trp Ala Ala Asn His Phe Ala Ser Val Leu Val Leu Ile Arg Glu Gln
                                   25                               30                               35

tta gac gta tca agc gtg ctg gtc aac ggc gct ttt ggt att tat gca 259
Leu Asp Val Ser Ser Val Leu Val Asn Gly Ala Phe Gly Ile Tyr Ala
                                   40                               45                               50

ctg gga ctt ctt cca agt ttg ctc gca ggc ggt gtg ctt gcc gac cgt 307
Leu Gly Leu Leu Pro Ser Leu Leu Ala Gly Gly Val Leu Ala Asp Arg
                                   55                               60                               65

ttt ggt gcc cgc atg gtg gta ctc acc gga ggt gta ctt tct gcg ctt 355
Phe Gly Ala Arg Met Val Val Leu Thr Gly Gly Val Leu Ser Ala Leu
                                   70                               75                               80                               85

gga aac ctt tct ctt tta gcg ttt cat gat ggt cct tcc ctc ctg gta 403
Gly Asn Leu Ser Leu Leu Ala Phe His Asp Gly Pro Ser Leu Leu Val
                                   90                               95                               100

gga cga ttc atc gtt ggt ctg ggc gtt gga tta gtc gtc agc gcg ggc 451
Gly Arg Phe Ile Val Gly Leu Gly Val Gly Leu Val Val Ser Ala Gly
                                   105                               110                               115

acc gca tgg gcg ggc aga ttg cgc gga gca agc ggc gtg aca ttg gcc 499
Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala Ser Gly Val Thr Leu Ala
                                   120                               125                               130

ggc att att ctg acc gcc ggt ttc atg atg ggg ccg att gtg aca agt 547
Gly Ile Ile Leu Thr Ala Gly Phe Met Met Gly Pro Ile Val Thr Ser
                                   135                               140                               145

ggg ttg ggg atg gcg tcg aca agc att att acg ccc ttt gcc ata agc 595
Gly Leu Gly Met Ala Ser Thr Ser Ile Ile Thr Pro Phe Ala Ile Ser
150                               155                               160                               165

```



gtt gcc ctc tcg ctg atc gcg gtg gtt gtg gga ttt gcg ctt ggc gat	643
Val Ala Leu Ser Leu Ile Ala Val Val Val Gly Phe Ala Leu Gly Asp	
170 175 180	
gcc cgc agc acc ccg agc gca ctt ggc gca tcc agc gga atc aaa cac	691
Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala Ser Ser Gly Ile Lys His	
185 190 195	
gaa cga agc atg aaa aag gcc ctc gcg gtg tcc ttg ccg atg gca att	739
Glu Arg Ser Met Lys Lys Ala Leu Ala Val Ser Leu Pro Met Ala Ile	
200 205 210	
tgg gtg ttc agc tgc atc acc acc tcc ctg atc gtg atg tcc gcg cgc	787
Trp Val Phe Ser Cys Ile Thr Thr Ser Leu Ile Val Met Ser Ala Arg	
215 220 225	
atc gac tcc acc ttc ggc aac gcc att ctt ctc ccc gga atc ggc gcg	835
Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu Leu Pro Gly Ile Gly Ala	
230 235 240 245	
gcg atc gcc ttc agc gca ggc ctg atc gca caa ttt tta ggt agg aaa	883
Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala Gln Phe Leu Gly Arg Lys	
250 255 260	
ttc gcg tgg ggt cgt ggc tcc gga atc gtg ggc gcg ctg tgt gcc ctc	931
Phe Ala Trp Gly Arg Gly Ser Gly Ile Val Gly Ala Leu Cys Ala Leu	
265 270 275	
gcg ggt ttt gcg ctg gca gct ttt ggt ggc gac tcc att cca gtg tgg	979
Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly Asp Ser Ile Pro Val Trp	
280 285 290	
ctt ttc gtt atc gcc tcg atc ctg ttc ggc acc gca tat ggc ctc tgc	1027
Leu Phe Val Ile Ala Ser Ile Leu Phe Gly Thr Ala Tyr Gly Leu Cys	
295 300 305	
ctg cgc gaa ggc ctc ctc agc atc gaa act tac acg cca ctc aac cga	1075
Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr Tyr Thr Pro Leu Asn Arg	
310 315 320 325	
cgt ggc acc ggc atc ggc atc tat tat gtg ttc acg tat ttg gga ttc	1123
Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val Phe Thr Tyr Leu Gly Phe	
330 335 340	
ggg ctg cca gtg ctt ctc gac gcc ctc ctc ccg cac ctt ggc gcc tcc	1171
Gly Leu Pro Val Leu Leu Asp Ala Leu Leu Pro His Leu Gly Ala Ser	
345 350 355	
att ccg ctg tac gcg ctg gcg gcg ctc gcc ctt ggc tcc gca gta atc	1219
Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala Leu Gly Ser Ala Val Ile	
360 365 370	
cgc ggc gta caa atc aag cgc ggg tat gtg gtt tagatttcta cctacgacct	1272
Arg Gly Val Gln Ile Lys Arg Gly Tyr Val Val	
375 380	
gaa	1275

<210> 162  
 <211> 384  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 162

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Met Arg Ser Gly Asn Ala Asn Arg Val Phe Ile Gly Val Thr Ile Leu
 1           5           10           15

Leu Phe Thr Ala Gly Trp Ala Ala Asn His Phe Ala Ser Val Leu Val
          20           25           30

Leu Ile Arg Glu Gln Leu Asp Val Ser Ser Val Leu Val Asn Gly Ala
          35           40           45

Phe Gly Ile Tyr Ala Leu Gly Leu Leu Pro Ser Leu Leu Ala Gly Gly
          50           55           60

Val Leu Ala Asp Arg Phe Gly Ala Arg Met Val Val Leu Thr Gly Gly
          65           70           75           80

Val Leu Ser Ala Leu Gly Asn Leu Ser Leu Leu Ala Phe His Asp Gly
          85           90           95

Pro Ser Leu Leu Val Gly Arg Phe Ile Val Gly Leu Gly Val Gly Leu
          100          105          110

Val Val Ser Ala Gly Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala Ser
          115          120          125

Gly Val Thr Leu Ala Gly Ile Ile Leu Thr Ala Gly Phe Met Met Gly
          130          135          140

Pro Ile Val Thr Ser Gly Leu Gly Met Ala Ser Thr Ser Ile Ile Thr
          145          150          155          160

Pro Phe Ala Ile Ser Val Ala Leu Ser Leu Ile Ala Val Val Val Gly
          165          170          175

Phe Ala Leu Gly Asp Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala Ser
          180          185          190

Ser Gly Ile Lys His Glu Arg Ser Met Lys Lys Ala Leu Ala Val Ser
          195          200          205

Leu Pro Met Ala Ile Trp Val Phe Ser Cys Ile Thr Thr Ser Leu Ile
          210          215          220

Val Met Ser Ala Arg Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu Leu
          225          230          235          240

Pro Gly Ile Gly Ala Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala Gln
          245          250          255

Phe Leu Gly Arg Lys Phe Ala Trp Gly Arg Gly Ser Gly Ile Val Gly
  
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260	265	270
Ala Leu Cys Ala Leu Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly Asp		
275	280	285
Ser Ile Pro Val Trp Leu Phe Val Ile Ala Ser Ile Leu Phe Gly Thr		
290	295	300
Ala Tyr Gly Leu Cys Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr Tyr		
305	310	315
Thr Pro Leu Asn Arg Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val Phe		
325	330	335
Thr Tyr Leu Gly Phe Gly Leu Pro Val Leu Leu Asp Ala Leu Leu Pro		
340	345	350
His Leu Gly Ala Ser Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala Leu		
355	360	365
Gly Ser Ala Val Ile Arg Gly Val Gln Ile Lys Arg Gly Tyr Val Val		
370	375	380

<210> 163  
 <211> 1130  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (1)..(1107)  
 <223> FRXA01922

<400> 163  
 ctg ctg ttt act gca gga tgg gca gcc aat cat ttc gcg tca gtg ttg 48  
 Leu Leu Phe Thr Ala Gly Trp Ala Ala Asn His Phe Ala Ser Val Leu  
 1 5 10 15  
 gtg ttg atc cgt gaa caa tta gac gta tca agc gtg ctg gtc aac ggc 96  
 Val Leu Ile Arg Glu Gln Leu Asp Val Ser Ser Val Leu Val Asn Gly  
 20 25 30  
 gct ttt ggt att tat gca ctg gga ctt ctt cca agt ttg ctc gca ggc 144  
 Ala Phe Gly Ile Tyr Ala Leu Gly Leu Leu Pro Ser Leu Leu Ala Gly  
 35 40 45  
 ggt gtg ctt gcc gac cgt ttt ggt gcc cgc atg gtg gta ctc acc gga 192  
 Gly Val Leu Ala Asp Arg Phe Gly Ala Arg Met Val Val Leu Thr Gly  
 50 55 60  
 ggt gta ctt tct gcg ctt gga aac ctt tct ctt tta gcg ttt cat gat 240  
 Gly Val Leu Ser Ala Leu Gly Asn Leu Ser Leu Leu Ala Phe His Asp  
 65 70 75 80

ggt cct tcc ctc ctg gta gga cga ttc atc gtt ggt ctg ggc gtt gga Gly Pro Ser Leu Leu Val Gly Arg Phe Ile Val Gly Leu Gly Val Gly	288
85 90 95	
tta gtc gtc agc gcg ggc acc gca tgg gcg ggc aga ttg cgc gga gca Leu Val Val Ser Ala Gly Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala	336
100 105 110	
agc ggc gtg aca ttg gcc ggc att att ctg acc gcc ggt ttc atg atg Ser Gly Val Thr Leu Ala Gly Ile Ile Leu Thr Ala Gly Phe Met Met	384
115 120 125	
ggg ccg att gtg aca agt ggg ttg ggg atg gcg tcg aca agc att att Gly Pro Ile Val Thr Ser Gly Leu Gly Met Ala Ser Thr Ser Ile Ile	432
130 135 140	
acg ccc ttt gcc ata agc gtt gcc ctc tcg ctg atc gcg gtg gtt gtg Thr Pro Phe Ala Ile Ser Val Ala Leu Ser Leu Ile Ala Val Val Val	480
145 150 155 160	
gga ttt gcg ctt ggc gat gcc cgc agc acc ccg agc gca ctt ggc gca Gly Phe Ala Leu Gly Asp Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala	528
165 170 175	
tcc agc gga atc aaa cac gaa cga agc atg aaa aag gcc ctc gcg gtg Ser Ser Gly Ile Lys His Glu Arg Ser Met Lys Lys Ala Leu Ala Val	576
180 185 190	
tcc ttg ccg atg gca att tgg gtg ttc agc tgc atc acc acc tcc ctg Ser Leu Pro Met Ala Ile Trp Val Phe Ser Cys Ile Thr Thr Ser Leu	624
195 200 205	
atc gtg atg tcc gcg cgc atc gac tcc acc ttc ggc aac gcc att ctt Ile Val Met Ser Ala Arg Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu	672
210 215 220	
ctc ccc gga atc ggc gcg gcg atc gcc ttc agc gca ggc ctg atc gca Leu Pro Gly Ile Gly Ala Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala	720
225 230 235 240	
caa ttt tta ggt agg aaa ttc gcg tgg ggt cgt ggc tcc gga atc gtg Gln Phe Leu Gly Arg Lys Phe Ala Trp Gly Arg Gly Ser Gly Ile Val	768
245 250 255	
ggc gcg ctg tgt gcc ctc gcg ggt ttt gcg ctg gca gct ttt ggt ggc Gly Ala Leu Cys Ala Leu Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly	816
260 265 270	
gac tcc att cca gtg tgg ctt ttc gtt atc gcc tcg atc ctg ttc ggc Asp Ser Ile Pro Val Trp Leu Phe Val Ile Ala Ser Ile Leu Phe Gly	864
275 280 285	
acc gca tat ggc ctc tgc ctg cgc gaa ggc ctc ctc agc atc gaa act Thr Ala Tyr Gly Leu Cys Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr	912
290 295 300	

tac acg cca ctc aac cga cgt ggc acc ggc atc ggc atc tat tat gtg 960  
 Tyr Thr Pro Leu Asn Arg Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val  
 305 310 315 320  
  
 ttc acg tat ttg gga ttc ggg ctg cca gtg ctt ctc gac gcc ctc ctc 1008  
 Phe Thr Tyr Leu Gly Phe Gly Leu Pro Val Leu Leu Asp Ala Leu Leu  
 325 330 335  
  
 ccg cac ctt ggc gcc tcc att ccg ctg tac gcg ctg gcg gcg ctc gcc 1056  
 Pro His Leu Gly Ala Ser Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala  
 340 345 350  
  
 ctt ggc tcc gca gta atc cgc ggc gta caa atc aag cgc ggg tat gtg 1104  
 Leu Gly Ser Ala Val Ile Arg Gly Val Gln Ile Lys Arg Gly Tyr Val  
 355 360 365  
  
 gtt tagatttcta cctacgacct gaa 1130  
 Val

<210> 164  
 <211> 369  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 164  
 Leu Leu Phe Thr Ala Gly Trp Ala Ala Asn His Phe Ala Ser Val Leu  
 1 5 10 15  
  
 Val Leu Ile Arg Glu Gln Leu Asp Val Ser Ser Val Leu Val Asn Gly  
 20 25 30  
  
 Ala Phe Gly Ile Tyr Ala Leu Gly Leu Leu Pro Ser Leu Leu Ala Gly  
 35 40 45  
  
 Gly Val Leu Ala Asp Arg Phe Gly Ala Arg Met Val Val Leu Thr Gly  
 50 55 60  
  
 Gly Val Leu Ser Ala Leu Gly Asn Leu Ser Leu Leu Ala Phe His Asp  
 65 70 75 80  
  
 Gly Pro Ser Leu Leu Val Gly Arg Phe Ile Val Gly Leu Gly Val Gly  
 85 90 95  
  
 Leu Val Val Ser Ala Gly Thr Ala Trp Ala Gly Arg Leu Arg Gly Ala  
 100 105 110  
  
 Ser Gly Val Thr Leu Ala Gly Ile Ile Leu Thr Ala Gly Phe Met Met  
 115 120 125  
  
 Gly Pro Ile Val Thr Ser Gly Leu Gly Met Ala Ser Thr Ser Ile Ile  
 130 135 140  
  
 Thr Pro Phe Ala Ile Ser Val Ala Leu Ser Leu Ile Ala Val Val Val  
 145 150 155 160

Gly Phe Ala Leu Gly Asp Ala Arg Ser Thr Pro Ser Ala Leu Gly Ala  
 165 170 175  
 Ser Ser Gly Ile Lys His Glu Arg Ser Met Lys Lys Ala Leu Ala Val  
 180 185 190  
 Ser Leu Pro Met Ala Ile Trp Val Phe Ser Cys Ile Thr Thr Ser Leu  
 195 200 205  
 Ile Val Met Ser Ala Arg Ile Asp Ser Thr Phe Gly Asn Ala Ile Leu  
 210 215 220  
 Leu Pro Gly Ile Gly Ala Ala Ile Ala Phe Ser Ala Gly Leu Ile Ala  
 225 230 235 240  
 Gln Phe Leu Gly Arg Lys Phe Ala Trp Gly Arg Gly Ser Gly Ile Val  
 245 250 255  
 Gly Ala Leu Cys Ala Leu Ala Gly Phe Ala Leu Ala Ala Phe Gly Gly  
 260 265 270  
 Asp Ser Ile Pro Val Trp Leu Phe Val Ile Ala Ser Ile Leu Phe Gly  
 275 280 285  
 Thr Ala Tyr Gly Leu Cys Leu Arg Glu Gly Leu Leu Ser Ile Glu Thr  
 290 295 300  
 Tyr Thr Pro Leu Asn Arg Arg Gly Thr Gly Ile Gly Ile Tyr Tyr Val  
 305 310 315 320  
 Phe Thr Tyr Leu Gly Phe Gly Leu Pro Val Leu Leu Asp Ala Leu Leu  
 325 330 335  
 Pro His Leu Gly Ala Ser Ile Pro Leu Tyr Ala Leu Ala Ala Leu Ala  
 340 345 350  
 Leu Gly Ser Ala Val Ile Arg Gly Val Gln Ile Lys Arg Gly Tyr Val  
 355 360 365

Val

<210> 165  
 <211> 362  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (1)..(339)  
 <223> RXA02060

<400> 165  
 gaa ttt gcc cgc att ttg aag cca aag gga cag gtc atc gtg ctt acc 48  
 Glu Phe Ala Arg Ile Leu Lys Pro Lys Gly Gln Val Ile Val Leu Thr  
 1 5 10 15



gca gat acc ggc cac ttg gct gag ctt cgt gaa cca ctg ggc atc att 96  
 Ala Asp Thr Gly His Leu Ala Glu Leu Arg Glu Pro Leu Gly Ile Ile  
                   20                                  25                                  30

gat gtg gag gcc ggc aaa gtt gat cgc atg atc gaa caa gcg gca ggc 144  
 Asp Val Glu Ala Gly Lys Val Asp Arg Met Ile Glu Gln Ala Ala Gly  
                   35                                  40                                  45

cac ctc aag cca gtt ggc gaa aga gac ttg gtg gaa ttt gaa atg ctg 192  
 His Leu Lys Pro Val Gly Glu Arg Asp Leu Val Glu Phe Glu Met Leu  
                   50                                  55                                  60

ctg gat caa aaa tcc att gca tct cag atc ggt atg agc cct tct gca 240  
 Leu Asp Gln Lys Ser Ile Ala Ser Gln Ile Gly Met Ser Pro Ser Ala  
                   65                                  70                                  75                                  80

cgc cac att aag cct gag gct ttg gcg gaa cgc atc gcc gct cta cca 288  
 Arg His Ile Lys Pro Glu Ala Leu Ala Glu Arg Ile Ala Ala Leu Pro  
                                   85                                  90                                  95

gaa caa atg aag gtt aca gcc cgg gcc aag atc acc agg ctg gaa cgc 336  
 Glu Gln Met Lys Val Thr Ala Arg Ala Lys Ile Thr Arg Leu Glu Arg  
                   100                                  105                                  110

atc taactcttat ctactgggc ctt 362  
 Ile

<210> 166  
 <211> 113  
 <212> PRT  
 <213> *Corynebacterium glutamicum*

<400> 166  
 Glu Phe Ala Arg Ile Leu Lys Pro Lys Gly Gln Val Ile Val Leu Thr  
   1                                  5                                  10                                  15

Ala Asp Thr Gly His Leu Ala Glu Leu Arg Glu Pro Leu Gly Ile Ile  
                   20                                  25                                  30

Asp Val Glu Ala Gly Lys Val Asp Arg Met Ile Glu Gln Ala Ala Gly  
                   35                                  40                                  45

His Leu Lys Pro Val Gly Glu Arg Asp Leu Val Glu Phe Glu Met Leu  
                   50                                  55                                  60

Leu Asp Gln Lys Ser Ile Ala Ser Gln Ile Gly Met Ser Pro Ser Ala  
   65                                  70                                  75                                  80

Arg His Ile Lys Pro Glu Ala Leu Ala Glu Arg Ile Ala Ala Leu Pro  
                   85                                  90                                  95

Glu Gln Met Lys Val Thr Ala Arg Ala Lys Ile Thr Arg Leu Glu Arg  
                   100                                  105                                  110

Ile

<210> 167  
 <211> 1395  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1372)  
 <223> RXN01936

&lt;400&gt; 167

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gcgcggtgac accacagccg ttgtcagcgg cgcttggtct gtggaggatc gccgaggtta 60

ctaacaaata ggcccaacaa agaggtctaa gctctacctg gtg agt ttc cga gat 115
                               Val Ser Phe Arg Asp
                               1                               5

att ttc gct gac acc aga ccg ctg aaa gaa ccg gcc ttc aaa cgc ctc 163
Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro Ala Phe Lys Arg Leu
                               10                               15                               20

tgg ctt ggc aat gtt gcc acc gtc att ggt gcc caa tta act gtt gtt 211
Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala Gln Leu Thr Val Val
                               25                               30                               35

gcc gtt ccg gtg cag att tac caa atg act ggg tcc tcc ggc tat gtg 259
Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly Ser Ser Gly Tyr Val
                               40                               45                               50

ggc ttg acc ggg ctt ttt ggc ctt att cct ttg gtt att ttt ggc ctt 307
Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu Val Ile Phe Gly Leu
                               55                               60                               65

tat ggt gga tcc att gcg gat gct ttt gat aaa cgc atc gtg ctg atc 355
Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys Arg Ile Val Leu Ile
                               70                               75                               80                               85

tgc acc acg atc ggc atg tgt gtc acc act gcc ggt ttt tgg gtg ctg 403
Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala Gly Phe Trp Val Leu
                               90                               95                               100

acc att tta ggc aat gag aat att tgg ctc ctg tta ata aac ttt tct 451
Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu Leu Ile Asn Phe Ser
                               105                               110                               115

tta cag cag gca ttt ttc gcg gtg aat caa ccc acc cga acg gcg atc 499
Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro Thr Arg Thr Ala Ile
                               120                               125                               130

ctt cga agt att ttg ccg att gat caa tta gcg tcg gca aca tca ctg 547
Leu Arg Ser Ile Leu Pro Ile Asp Gln Leu Ala Ser Ala Thr Ser Leu
                               135                               140                               145

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aat atg ctg ctc atg cag acc ggc gca atc gtt ggc ccg ctg atc gca	595
Asn Met Leu Leu Met Gln Thr Gly Ala Ile Val Gly Pro Leu Ile Ala	
150 155 160 165	
ggg ggc ttg att ccg ctg atc ggt ttc ggg tgg ctg tat ttc ctt gat	643
Gly Ala Leu Ile Pro Leu Ile Gly Phe Gly Trp Leu Tyr Phe Leu Asp	
170 175 180	
gtt gtc tcc atc atc ccc aca ctg tgg gct gta tgg tca ctg cct tcg	691
Val Val Ser Ile Ile Pro Thr Leu Trp Ala Val Trp Ser Leu Pro Ser	
185 190 195	
atc aag cca tcc ggc aag gtg atg aag gct ggt ttc gcc agt gtg gtg	739
Ile Lys Pro Ser Gly Lys Val Met Lys Ala Gly Phe Ala Ser Val Val	
200 205 210	
gat ggc ctg aag tat ttg gct ggc caa ccc gtg ttg ttg atg gtg atg	787
Asp Gly Leu Lys Tyr Leu Ala Gly Gln Pro Val Leu Leu Met Val Met	
215 220 225	
gtg ctg gat ctt atc gcc atg att ttc ggc atg cca cgt gcg ctt tac	835
Val Leu Asp Leu Ile Ala Met Ile Phe Gly Met Pro Arg Ala Leu Tyr	
230 235 240 245	
ccc gag atc gca gaa gtg aac ttc ggt ggc ggt gac gcc ggt gca acg	883
Pro Glu Ile Ala Glu Val Asn Phe Gly Gly Gly Asp Ala Gly Ala Thr	
250 255 260	
atg ctg gcg ttc atg tac tca tcc atg gct gtt ggc gca gtt ctt ggc	931
Met Leu Ala Phe Met Tyr Ser Ser Met Ala Val Gly Ala Val Leu Gly	
265 270 275	
ggc gtg ctg tct ggt tgg gtg gcc cgg att agc cgc cag ggt gtt gca	979
Gly Val Leu Ser Gly Trp Val Ala Arg Ile Ser Arg Gln Gly Val Ala	
280 285 290	
gtt tat tgg tgc atc atc gcc tgg ggc gca gcc gtt gct ttg ggt ggt	1027
Val Tyr Trp Cys Ile Ile Ala Trp Gly Ala Ala Val Ala Leu Gly Gly	
295 300 305	
gtg gca att gtt gtc agc ccc ggc gcg gtg act gcg tgg gcg tgg atg	1075
Val Ala Ile Val Val Ser Pro Gly Ala Val Thr Ala Trp Ala Trp Met	
310 315 320 325	
ttc atc atc atg atg gtc att ggt ggc atg gct gac atg ttc agc tcg	1123
Phe Ile Ile Met Met Val Ile Gly Gly Met Ala Asp Met Phe Ser Ser	
330 335 340	
gca gtt cga aac gct att ttg cag cag tct gct gcg gaa cat gtg cag	1171
Ala Val Arg Asn Ala Ile Leu Gln Gln Ser Ala Ala Glu His Val Gln	
345 350 355	
ggc cga atc caa ggt gtg tgg atc atc gtc gtg gtg ggt gga cct cgt	1219
Gly Arg Ile Gln Gly Val Trp Ile Ile Val Val Val Gly Gly Pro Arg	
360 365 370	
tta gct gac gtc ctt cac ggt tgg gcc gct gag ccc ctc ggc gca ggt	1267

Leu Ala Asp Val Leu His Gly Trp Ala Ala Glu Pro Leu Gly Ala Gly  
 375 380 385  
 tgg acg gta tta tgg ggc gga gta gcg gtg gtt gta ctc act gca att 1315  
 Trp Thr Val Leu Trp Gly Gly Val Ala Val Val Val Leu Thr Ala Ile  
 390 395 400 405  
 tgt atg gtg gcg gtg cct aaa ttc tgg aaa tac gag aaa cca aaa att 1363  
 Cys Met Val Ala Val Pro Lys Phe Trp Lys Tyr Glu Lys Pro Lys Ile  
 410 415 420  
 acc ggc atc taaataactta tccatgccca ttt 1395  
 Thr Gly Ile

&lt;210&gt; 168

&lt;211&gt; 424

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 168

Val Ser Phe Arg Asp Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro  
 1 5 10 15  
 Ala Phe Lys Arg Leu Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala  
 20 25 30  
 Gln Leu Thr Val Val Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly  
 35 40 45  
 Ser Ser Gly Tyr Val Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu  
 50 55 60  
 Val Ile Phe Gly Leu Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys  
 65 70 75 80  
 Arg Ile Val Leu Ile Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala  
 85 90 95  
 Gly Phe Trp Val Leu Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu  
 100 105 110  
 Leu Ile Asn Phe Ser Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro  
 115 120 125  
 Thr Arg Thr Ala Ile Leu Arg Ser Ile Leu Pro Ile Asp Gln Leu Ala  
 130 135 140  
 Ser Ala Thr Ser Leu Asn Met Leu Leu Met Gln Thr Gly Ala Ile Val  
 145 150 155 160  
 Gly Pro Leu Ile Ala Gly Ala Leu Ile Pro Leu Ile Gly Phe Gly Trp  
 165 170 175  
 Leu Tyr Phe Leu Asp Val Val Ser Ile Ile Pro Thr Leu Trp Ala Val  
 180 185 190

Trp Ser Leu Pro Ser Ile Lys Pro Ser Gly Lys Val Met Lys Ala Gly  
 195 200 205  
 Phe Ala Ser Val Val Asp Gly Leu Lys Tyr Leu Ala Gly Gln Pro Val  
 210 215 220  
 Leu Leu Met Val Met Val Leu Asp Leu Ile Ala Met Ile Phe Gly Met  
 225 230 235 240  
 Pro Arg Ala Leu Tyr Pro Glu Ile Ala Glu Val Asn Phe Gly Gly Gly  
 245 250 255  
 Asp Ala Gly Ala Thr Met Leu Ala Phe Met Tyr Ser Ser Met Ala Val  
 260 265 270  
 Gly Ala Val Leu Gly Gly Val Leu Ser Gly Trp Val Ala Arg Ile Ser  
 275 280 285  
 Arg Gln Gly Val Ala Val Tyr Trp Cys Ile Ile Ala Trp Gly Ala Ala  
 290 295 300  
 Val Ala Leu Gly Gly Val Ala Ile Val Val Ser Pro Gly Ala Val Thr  
 305 310 315 320  
 Ala Trp Ala Trp Met Phe Ile Ile Met Met Val Ile Gly Gly Met Ala  
 325 330 335  
 Asp Met Phe Ser Ser Ala Val Arg Asn Ala Ile Leu Gln Gln Ser Ala  
 340 345 350  
 Ala Glu His Val Gln Gly Arg Ile Gln Gly Val Trp Ile Ile Val Val  
 355 360 365  
 Val Gly Gly Pro Arg Leu Ala Asp Val Leu His Gly Trp Ala Ala Glu  
 370 375 380  
 Pro Leu Gly Ala Gly Trp Thr Val Leu Trp Gly Gly Val Ala Val Val  
 385 390 395 400  
 Val Leu Thr Ala Ile Cys Met Val Ala Val Pro Lys Phe Trp Lys Tyr  
 405 410 415  
 Glu Lys Pro Lys Ile Thr Gly Ile  
 420

<210> 169  
 <211> 945  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(922)  
 <223> FRXA01936

&lt;400&gt; 169

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tttgccgatt gatcaataag cgctcggcaac atcactgaat atg ctg ctc atg cag 115  
 Met Leu Leu Met Gln  
 1 5

acc ggc gca atc gtt ggc ccg ctg atc gca ggt gcg ttg att ccg ctg 163  
 Thr Gly Ala Ile Val Gly Pro Leu Ile Ala Gly Ala Leu Ile Pro Leu  
 10 15 20

atc ggt ttc ggg tgg ctg tat ttc ctt gat gtt gtc tcc atc atc ccc 211  
 Ile Gly Phe Gly Trp Leu Tyr Phe Leu Asp Val Val Ser Ile Ile Pro  
 25 30 35

aca ctg tgg gct gta tgg tca ctg cct tcg atc aag cca tcc ggc aag 259  
 Thr Leu Trp Ala Val Trp Ser Leu Pro Ser Ile Lys Pro Ser Gly Lys  
 40 45 50

gtg atg aag gct ggt ttc gcc agt gtg gtg gat ggc ctg aag tat ttg 307  
 Val Met Lys Ala Gly Phe Ala Ser Val Val Asp Gly Leu Lys Tyr Leu  
 55 60 65

gct ggc caa ccc gtg ttg ttg atg gtg atg gtg ctg gat ctt atc gcc 355  
 Ala Gly Gln Pro Val Leu Leu Met Val Met Val Leu Asp Leu Ile Ala  
 70 75 80 85

atg att ttc ggc atg cca cgt gcg ctt tac ccc gag atc gca gaa gtg 403  
 Met Ile Phe Gly Met Pro Arg Ala Leu Tyr Pro Glu Ile Ala Glu Val  
 90 95 100

aac ttc ggt ggg ggt gac gcc ggt gca acg atg ctg gcg ttc atg tac 451  
 Asn Phe Gly Gly Gly Asp Ala Gly Ala Thr Met Leu Ala Phe Met Tyr  
 105 110 115

tca tcc atg gct gtt ggc gca gtt ctt ggc ggc gtg ctg tct ggt tgg 499  
 Ser Ser Met Ala Val Gly Ala Val Leu Gly Gly Val Leu Ser Gly Trp  
 120 125 130

gtg gcc ccg att agc cgc cag ggt gtt gca gtt tat tgg tgc atc atc 547  
 Val Ala Arg Ile Ser Arg Gln Gly Val Ala Val Tyr Trp Cys Ile Ile  
 135 140 145

gcc tgg ggc gca gcc gtt gct ttg ggt ggt gtg gca att gtt gtc agc 595  
 Ala Trp Gly Ala Ala Val Ala Leu Gly Gly Val Ala Ile Val Val Ser  
 150 155 160 165

ccc ggc gcg gtg act gcg tgg gcg tgg atg ttc atc atc atg atg gtc 643  
 Pro Gly Ala Val Thr Ala Trp Ala Trp Met Phe Ile Ile Met Met Val  
 170 175 180

att ggt ggc atg gct gac atg ttc agc tcg gca gtt cga aac gct att 691  
 Ile Gly Gly Met Ala Asp Met Phe Ser Ser Ala Val Arg Asn Ala Ile  
 185 190 195

ttg cag cag tct gct gcg gaa cat gtg cag ggc cga atc caa ggt gtg 739  
 Leu Gln Gln Ser Ala Ala Glu His Val Gln Gly Arg Ile Gln Gly Val



200	205	210	
tgg atc atc gtc gtg gtg ggt gga cct cgt tta gct gac gtc ctt cac			787
Trp Ile Ile Val Val Val Gly Gly Pro Arg Leu Ala Asp Val Leu His			
215	220	225	
ggt tgg gcc gct gag ccc ctc ggc gca ggt tgg acg gta tta tgg ggc			835
Gly Trp Ala Ala Glu Pro Leu Gly Ala Gly Trp Thr Val Leu Trp Gly			
230	235	240	245
gga gta gcg gtg gtt gta ctc act gca att tgt atg gtg gcg gtg cct			883
Gly Val Ala Val Val Val Leu Thr Ala Ile Cys Met Val Ala Val Pro			
	250	255	260
aaa ttc tgg aaa tac gag aaa cca aaa att acc ggc atc taaataactta			932
Lys Phe Trp Lys Tyr Glu Lys Pro Lys Ile Thr Gly Ile			
	265	270	
tccatgccca ttt			945

<210> 170  
 <211> 274  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 170  
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 Ala Leu Ile Pro Leu Ile Gly Phe Gly Trp Leu Tyr Phe Leu Asp Val  
 20 25 30  
 Val Ser Ile Ile Pro Thr Leu Trp Ala Val Trp Ser Leu Pro Ser Ile  
 35 40 45  
 Lys Pro Ser Gly Lys Val Met Lys Ala Gly Phe Ala Ser Val Val Asp  
 50 55 60  
 Gly Leu Lys Tyr Leu Ala Gly Gln Pro Val Leu Leu Met Val Met Val  
 65 70 75 80  
 Leu Asp Leu Ile Ala Met Ile Phe Gly Met Pro Arg Ala Leu Tyr Pro  
 85 90 95  
 Glu Ile Ala Glu Val Asn Phe Gly Gly Gly Asp Ala Gly Ala Thr Met  
 100 105 110  
 Leu Ala Phe Met Tyr Ser Ser Met Ala Val Gly Ala Val Leu Gly Gly  
 115 120 125  
 Val Leu Ser Gly Trp Val Ala Arg Ile Ser Arg Gln Gly Val Ala Val  
 130 135 140  
 Tyr Trp Cys Ile Ile Ala Trp Gly Ala Ala Val Ala Leu Gly Gly Val  
 145 150 155 160

Ala Ile Val Val Ser Pro Gly Ala Val Thr Ala Trp Ala Trp Met Phe  
 165 170 175

Ile Ile Met Met Val Ile Gly Gly Met Ala Asp Met Phe Ser Ser Ala  
 180 185 190

Val Arg Asn Ala Ile Leu Gln Gln Ser Ala Ala Glu His Val Gln Gly  
 195 200 205

Arg Ile Gln Gly Val Trp Ile Ile Val Val Val Gly Gly Pro Arg Leu  
 210 215 220

Ala Asp Val Leu His Gly Trp Ala Ala Glu Pro Leu Gly Ala Gly Trp  
 225 230 235 240

Thr Val Leu Trp Gly Gly Val Ala Val Val Val Leu Thr Ala Ile Cys  
 245 250 255

Met Val Ala Val Pro Lys Phe Trp Lys Tyr Glu Lys Pro Lys Ile Thr  
 260 265 270

Gly Ile

<210> 171  
 <211> 549  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(526)  
 <223> FRXA01937

<400> 171  
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ctaacaaata ggcccaacaa agaggtctaa gctctacctg gtg agt ttc cga gat 115  
 Val Ser Phe Arg Asp  
 1 5

att ttc gct gac acc aga ccg ctg aaa gaa ccg gcc ttc aaa cgc ctc 163  
 Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro Ala Phe Lys Arg Leu  
 10 15 20

tgg ctt ggc aat gtt gcc acc gtc att ggt gcc caa tta act gtt gtt 211  
 Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala Gln Leu Thr Val Val  
 25 30 35

gcc gtt ccg gtg cag att tac caa atg act ggg tcc tcc ggc tat gtg 259  
 Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly Ser Ser Gly Tyr Val  
 40 45 50

ggc ttg acc ggg ctt ttt ggc ctt att cct ttg gtt att ttt ggc ctt 307  
 Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu Val Ile Phe Gly Leu  
 55 60 65

tat ggt gga tcc att gcg gat gct ttt gat aaa cgc atc gtg ctg atc 355  
 Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys Arg Ile Val Leu Ile  
 70 75 80 85

tgc acc acg atc ggc atg tgt gtc acc act gcc ggt ttt tgg gtg ctg 403  
 Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala Gly Phe Trp Val Leu  
 90 95 100

acc att tta ggc aat gag aat att tgg ctc ctg tta ata aac ttt tct 451  
 Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu Leu Ile Asn Phe Ser  
 105 110 115

tta cag cag gca ttt ttc gcg gtg aat caa ccc acc cga acg gcg atc 499  
 Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro Thr Arg Thr Ala Ile  
 120 125 130

ctt cga agt att ttg ccg att gat caa taagcgtcgg caacatcact 546  
 Leu Arg Ser Ile Leu Pro Ile Asp Gln  
 135 140

gaa 549

<210> 172

<211> 142

<212> PRT

<213> Corynebacterium glutamicum

<400> 172

Val Ser Phe Arg Asp Ile Phe Ala Asp Thr Arg Pro Leu Lys Glu Pro  
 1 5 10 15

Ala Phe Lys Arg Leu Trp Leu Gly Asn Val Ala Thr Val Ile Gly Ala  
 20 25 30

Gln Leu Thr Val Val Ala Val Pro Val Gln Ile Tyr Gln Met Thr Gly  
 35 40 45

Ser Ser Gly Tyr Val Gly Leu Thr Gly Leu Phe Gly Leu Ile Pro Leu  
 50 55 60

Val Ile Phe Gly Leu Tyr Gly Gly Ser Ile Ala Asp Ala Phe Asp Lys  
 65 70 75 80

Arg Ile Val Leu Ile Cys Thr Thr Ile Gly Met Cys Val Thr Thr Ala  
 85 90 95

Gly Phe Trp Val Leu Thr Ile Leu Gly Asn Glu Asn Ile Trp Leu Leu  
 100 105 110

Leu Ile Asn Phe Ser Leu Gln Gln Ala Phe Phe Ala Val Asn Gln Pro  
 115 120 125

Thr Arg Thr Ala Ile Leu Arg Ser Ile Leu Pro Ile Asp Gln  
 130 135 140

<210> 173  
 <211> 1242  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1219)  
 <223> RXN01010

<400> 173

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gtgccaaagc gtttcctgta aaacgcataa ccccgaatac cccctgtttc cagatccaaa 60

aaaagatctg gcaggggggtt taggcataga ttaggaactt atg aag aaa ctg caa 115
                                         Met Lys Lys Leu Gln
                                         1                               5

atg ccg gcc att ttg gtc gga ggc ttt gtg ggg ccg ttt act ggc caa 163
Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly Pro Phe Thr Gly Gln
                        10                        15                        20

gct cta tca gtg gtc ttg ccg gaa ttt gca gac acc ttt gat atc agt 211
Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp Thr Phe Asp Ile Ser
                        25                        30                        35

gtc agc cag gca gcg ctg acc atg acc gca tac ttg ttg ccc ttt gcc 259
Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr Leu Leu Pro Phe Ala
                        40                        45                        50

acc atg atg ttg ttt tcg ggg cgc atc acc aga aag atc cat ccg cat 307
Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg Lys Ile His Pro His
                        55                        60                        65

aag gtg gtg cag gcg gct tat att gtc aca ctg cca ctt gcg ctg ttg 355
Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu Pro Leu Ala Leu Leu
                        70                        75                        80                        85

ctc cta gtt aca cca tcg tgg ggg ctg ttt atg gct gcg tat gcc acg 403
Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met Ala Ala Tyr Ala Thr
                        90                        95                        100

att ggt atc gct aat gca ttt acc act ccg gtg ctg caa att atg ttg 451
Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val Leu Gln Ile Met Leu
                        105                        110                        115

cgt gag ctt gtt ccg ccg cgt tct ttg ggt aag gca ttg ggc acc tat 499
Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys Ala Leu Gly Thr Tyr
                        120                        125                        130

gct gcg atg caa tca ctc ggc atg ttg tcg gcg cca ctg atc gca ggt 547
Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala Pro Leu Ile Ala Gly
                        135                        140                        145

gtg tct tcg gtg gtg tcg tgg agg ttg acc ttc ctg gtc act gca gca 595
Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe Leu Val Thr Ala Ala
150                        155                        160                        165

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gcg tca ctg ttt att ttg gtg gcg cga ctc ccc gtt gtt cca cca cca 643  
 Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro Val Val Pro Pro Pro  
 170 175 180

tca gca tcg aag caa aac gtt agt ggc aag gtg cag tgg gga ccg acc 691  
 Ser Ala Ser Lys Gln Asn Val Ser Gly Lys Val Gln Trp Gly Pro Thr  
 185 190 195

atc atc cac atg gtt tcc ggc ttt gtg gtg ggc atc ggc atc atc ggc 739  
 Ile Ile His Met Val Ser Gly Phe Val Val Gly Ile Gly Ile Ile Gly  
 200 205 210

att gga ttc atg aca tcg ctg cac gtt ggc gag caa ttc gga ctt gat 787  
 Ile Gly Phe Met Thr Ser Leu His Val Gly Glu Gln Phe Gly Leu Asp  
 215 220 225

gct gca gcg cgt ggt ttg gtg gtc atg tgt ggt ggc ctg gct gcg ttc 835  
 Ala Ala Ala Arg Gly Leu Val Val Met Cys Gly Gly Leu Ala Ala Phe  
 230 235 240 245

ttt gcc tcc cgc aag att ggc gat ttg gca gac aaa ttt ggt gtg cgc 883  
 Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp Lys Phe Gly Val Arg  
 250 255 260

gcg gtg ctc att gtc agt gct gtc atc ggt acc atc gca ctc gca ctg 931  
 Ala Val Leu Ile Val Ser Ala Val Ile Gly Thr Ile Ala Leu Ala Leu  
 265 270 275

ctg ccg atc gca ccg tgg atc att gtg gtg gcc gta ctg tgg gcc ttc 979  
 Leu Pro Ile Ala Pro Trp Ile Ile Val Val Ala Val Leu Trp Ala Phe  
 280 285 290

gca gta gca gca gca caa gga atc caa gca acc gtc aac ttg gct gtc 1027  
 Ala Val Ala Ala Ala Gln Gly Ile Gln Ala Thr Val Asn Leu Ala Val  
 295 300 305

atc gga agc ccc ggt gga tca tcg ctg ctt tct acc gtg cag gct ttc 1075  
 Ile Gly Ser Pro Gly Gly Ser Ser Leu Leu Ser Thr Val Gln Ala Phe  
 310 315 320 325

cga ttc ttc gga tca gcg gca gca cca gtg aca ttc ctt cct atc tat 1123  
 Arg Phe Phe Gly Ser Ala Ala Ala Pro Val Thr Phe Leu Pro Ile Tyr  
 330 335 340

atg ggc atc ggc tcg ggg gcg ttt tgg gtc agc gcg gta gcg ctg ttc 1171  
 Met Gly Ile Gly Ser Gly Ala Phe Trp Val Ser Ala Val Ala Leu Phe  
 345 350 355

ttc gtt gcc atc gcc cag tgg ctc aac ccg cag cgg gtg gag cgg ggc 1219  
 Phe Val Ala Ile Ala Gln Trp Leu Asn Pro Gln Arg Val Glu Arg Gly  
 360 365 370

tgaggagac gtcgagaagc gtc 1242

&lt;210&gt; 174

&lt;211&gt; 373

&lt;212&gt; PRT

<213> *Corynebacterium glutamicum*

&lt;400&gt; 174

Met Lys Lys Leu Gln Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly  
 1 5 10 15

Pro Phe Thr Gly Gln Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp  
 20 25 30

Thr Phe Asp Ile Ser Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr  
 35 40 45

Leu Leu Pro Phe Ala Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg  
 50 55 60

Lys Ile His Pro His Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu  
 65 70 75 80

Pro Leu Ala Leu Leu Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met  
 85 90 95

Ala Ala Tyr Ala Thr Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val  
 100 105 110

Leu Gln Ile Met Leu Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys  
 115 120 125

Ala Leu Gly Thr Tyr Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala  
 130 135 140

Pro Leu Ile Ala Gly Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe  
 145 150 155 160

Leu Val Thr Ala Ala Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro  
 165 170 175

Val Val Pro Pro Pro Ser Ala Ser Lys Gln Asn Val Ser Gly Lys Val  
 180 185 190

Gln Trp Gly Pro Thr Ile Ile His Met Val Ser Gly Phe Val Val Gly  
 195 200 205

Ile Gly Ile Ile Gly Ile Gly Phe Met Thr Ser Leu His Val Gly Glu  
 210 215 220

Gln Phe Gly Leu Asp Ala Ala Ala Arg Gly Leu Val Val Met Cys Gly  
 225 230 235 240

Gly Leu Ala Ala Phe Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp  
 245 250 255

Lys Phe Gly Val Arg Ala Val Leu Ile Val Ser Ala Val Ile Gly Thr  
 260 265 270

Ile Ala Leu Ala Leu Leu Pro Ile Ala Pro Trp Ile Ile Val Val Ala



275	280	285
Val Leu Trp Ala Phe Ala	Val Ala Ala Ala Gln Gly	Ile Gln Ala Thr
290	295	300
Val Asn Leu Ala Val Ile Gly Ser Pro Gly Gly Ser Ser Leu Leu Ser		
305	310	315
Thr Val Gln Ala Phe Arg Phe Phe Gly Ser Ala Ala Ala Pro Val Thr		
325	330	335
Phe Leu Pro Ile Tyr Met Gly Ile Gly Ser Gly Ala Phe Trp Val Ser		
340	345	350
Ala Val Ala Leu Phe Phe Val Ala Ile Ala Gln Trp Leu Asn Pro Gln		
355	360	365
Arg Val Glu Arg Gly		
370		

<210> 175  
 <211> 871  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(871)  
 <223> FRXA01010

<400> 175  
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 aaaagatctg gcaggggggtt taggcataga ttaggaactt atg aag aaa ctg caa 115  
 Met Lys Lys Leu Gln  
 1 5  
 atg ccg gcc att ttg gtc gga ggc ttt gtg ggg ccg ttt act ggc caa 163  
 Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly Pro Phe Thr Gly Gln  
 10 15 20  
 gct cta tca gtg gtc ttg ccg gaa ttt gca gac acc ttt gat atc agt 211  
 Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp Thr Phe Asp Ile Ser  
 25 30 35  
 gtc agc cag gca gcg ctg acc atg acc gca tac ttg ttg ccc ttt gcc 259  
 Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr Leu Leu Pro Phe Ala  
 40 45 50  
 acc atg atg ttg ttt tcg ggg cgc atc acc aga aag atc cat ccg cat 307  
 Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg Lys Ile His Pro His  
 55 60 65  
 aag gtg gtg cag gcg gct tat att gtc aca ctg cca ctt gcg ctg ttg 355  
 Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu Pro Leu Ala Leu Leu  
 70 75 80 85

ctc cta gtt aca cca tcg tgg ggg ctg ttt atg gct gcg tat gcc acg 403  
 Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met Ala Ala Tyr Ala Thr  
                     90                    95                    100

att ggt atc gct aat gca ttt acc act ccg gtg ctg caa att atg ttg 451  
 Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val Leu Gln Ile Met Leu  
                     105                    110                    115

cgt gag ctt gtt ccg ccg cgt tct ttg ggt aag gca ttg ggc acc tat 499  
 Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys Ala Leu Gly Thr Tyr  
                     120                    125                    130

gct gcg atg caa tca ctc ggc atg ttg tcg gcg cca ctg atc gca ggt 547  
 Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala Pro Leu Ile Ala Gly  
                     135                    140                    145

gtg tct tcg gtg gtg tcg tgg agg ttg acc ttc ctg gtc act gca gca 595  
 Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe Leu Val Thr Ala Ala  
                     150                    155                    160                    165

gcg tca ctg ttt att ttg gtg gcg cga ctc ccc gtt gtt cca cca cca 643  
 Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro Val Val Pro Pro Pro  
                     170                    175                    180

tca gca ttg aag caa aac gtt agt ggc aag gtg cag tgg gga ccg acc 691  
 Ser Ala Leu Lys Gln Asn Val Ser Gly Lys Val Gln Trp Gly Pro Thr  
                     185                    190                    195

atc atc cac atg gtt tcc ggc ttt gtg gtg ggc atc ggc atc atc ggc 739  
 Ile Ile His Met Val Ser Gly Phe Val Val Gly Ile Gly Ile Ile Gly  
                     200                    205                    210

att gga ttc atg aca tcg ctg cac gtt ggc gag caa ttc gga ctt aat 787  
 Ile Gly Phe Met Thr Ser Leu His Val Gly Glu Gln Phe Gly Leu Asn  
                     215                    220                    225

act gca gcg cgt ggt ttg gtg gtc atg tgt ggt ggc cgg gct gcg ttc 835  
 Thr Ala Ala Arg Gly Leu Val Val Met Cys Gly Gly Arg Ala Ala Phe  
                     230                    235                    240                    245

ttt gcc tcc cgc aag ata ggc gat ttg gca gac aaa 871  
 Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp Lys  
                     250                    255

&lt;210&gt; 176

&lt;211&gt; 257

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 176

Met Lys Lys Leu Gln Met Pro Ala Ile Leu Val Gly Gly Phe Val Gly  
           1                    5                    10                    15

Pro Phe Thr Gly Gln Ala Leu Ser Val Val Leu Pro Glu Phe Ala Asp  
                     20                    25                    30

Thr Phe Asp Ile Ser Val Ser Gln Ala Ala Leu Thr Met Thr Ala Tyr  
 35 40 45  
 Leu Leu Pro Phe Ala Thr Met Met Leu Phe Ser Gly Arg Ile Thr Arg  
 50 55 60  
 Lys Ile His Pro His Lys Val Val Gln Ala Ala Tyr Ile Val Thr Leu  
 65 70 75 80  
 Pro Leu Ala Leu Leu Leu Leu Val Thr Pro Ser Trp Gly Leu Phe Met  
 85 90 95  
 Ala Ala Tyr Ala Thr Ile Gly Ile Ala Asn Ala Phe Thr Thr Pro Val  
 100 105 110  
 Leu Gln Ile Met Leu Arg Glu Leu Val Pro Pro Arg Ser Leu Gly Lys  
 115 120 125  
 Ala Leu Gly Thr Tyr Ala Ala Met Gln Ser Leu Gly Met Leu Ser Ala  
 130 135 140  
 Pro Leu Ile Ala Gly Val Ser Ser Val Val Ser Trp Arg Leu Thr Phe  
 145 150 155 160  
 Leu Val Thr Ala Ala Ala Ser Leu Phe Ile Leu Val Ala Arg Leu Pro  
 165 170 175  
 Val Val Pro Pro Pro Ser Ala Leu Lys Gln Asn Val Ser Gly Lys Val  
 180 185 190  
 Gln Trp Gly Pro Thr Ile Ile His Met Val Ser Gly Phe Val Val Gly  
 195 200 205  
 Ile Gly Ile Ile Gly Ile Gly Phe Met Thr Ser Leu His Val Gly Glu  
 210 215 220  
 Gln Phe Gly Leu Asn Thr Ala Ala Arg Gly Leu Val Val Met Cys Gly  
 225 230 235 240  
 Gly Arg Ala Ala Phe Phe Ala Ser Arg Lys Ile Gly Asp Leu Ala Asp  
 245 250 255

Lys

<210> .177  
 <211> 1266  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1243)  
 <223> RXN03142

&lt;400&gt; 177

gcaatttggc caatcaacaa cataggagga ctgcgtggcg gtcaccgcaa gaacggacat 60

aaaaccacac ccatcgcaac caacggcact gttcactcca gtg ttt att ttg ggc 115  
 Val Phe Ile Leu Gly  
 1 5

tgg ctc gtc aac ttg acc cag tac ttg agc ttc tac ttc ctg atc aca 163  
 Trp Leu Val Asn Leu Thr Gln Tyr Leu Ser Phe Tyr Phe Leu Ile Thr  
 10 15 20

gtc atg gcg ctg tat gcg atg gaa agc ttc gcc gtt tca gag gcc gct 211  
 Val Met Ala Leu Tyr Ala Met Glu Ser Phe Ala Val Ser Glu Ala Ala  
 25 30 35

gtc gga ttt gcg gcc agc tcc ttt gtt atc ggc gca acc gtg gct cgt 259  
 Val Gly Phe Ala Ala Ser Ser Phe Val Ile Gly Ala Thr Val Ala Arg  
 40 45 50

gtg ttc gcg gga tgg acg tcc gac cgt ttt ggt aaa aaa cag atc ctg 307  
 Val Phe Ala Gly Trp Thr Ser Asp Arg Phe Gly Lys Lys Gln Ile Leu  
 55 60 65

ctc atc ttt gtc ggc ttg gaa gcg gta gca tca cta ttc tat att cca 355  
 Leu Ile Phe Val Gly Leu Glu Ala Val Ala Ser Leu Phe Tyr Ile Pro  
 70 75 80 85

gct gcc tca cta cca gcg ctg gtt gct gtg cgt ttt gtt cac ggt ttt 403  
 Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg Phe Val His Gly Phe  
 90 95 100

tct tat tct ctt gct tcc acc gct gtg atg gca ctt gtg cag tcc gtg 451  
 Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala Leu Val Gln Ser Val  
 105 110 115

att cct gca agc cgt agg gca gag ggc acc ggc tac ttc gcg ctc gga 499  
 Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly Tyr Phe Ala Leu Gly  
 120 125 130

tcc aca ctg gct aca gct ttc ggc cca gca att gcg ctg ttt gtt atc 547  
 Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile Ala Leu Phe Val Ile  
 135 140 145

gat gac ttc aac tac aac acc ctg ttc tgg att acc act gcg acc agt 595  
 Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile Thr Thr Ala Thr Ser  
 150 155 160 165

gtt ttc ggc ctg atc ctc acc gtt ttg atc cgc aag ccg gag ttc att 643  
 Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg Lys Pro Glu Phe Ile  
 170 175 180

aag aat gcg gaa cac ggc aga gta aag cca gtc tgg tct atc aag act 691  
 Lys Asn Ala Glu His Gly Arg Val Lys Pro Val Trp Ser Ile Lys Thr  
 185 190 195

gtt gtg cac cca tcg gtc atg ctc att gga ttc ttc atg ctc gct gtc 739  
 Val Val His Pro Ser Val Met Leu Ile Gly Phe Phe Met Leu Ala Val

200	205	210	
gga ctg gct tac gca ggc gtg atc acc ttc ctc aac ggc ttc gcg caa Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu Asn Gly Phe Ala Gln 215 220 225			787
gac act ggc ctc acc gcc gga gcg ggt ctt ttc ttt atc gct tat gcg Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe Phe Ile Ala Tyr Ala 230 235 240 245			835
gtt gcg atg ctg gtc atg cgt ttc ttc ctt gga cgc att cag gac aaa Val Ala Met Leu Val Met Arg Phe Phe Leu Gly Arg Ile Gln Asp Lys 250 255 260			883
cat ggt gac aac ccg gtt att tac ttc ggt ttg atc agc ttc gcc ctc His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu Ile Ser Phe Ala Leu 265 270 275			931
gcg ctg ggg ctt atg gct ttg gcg act gaa gac tgg cac att gtt ctc Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp Trp His Ile Val Leu 280 285 290			979
gct ggc gca ctc acc ggt ttg ggc tat ggc acc atc atg ccg gcc gca Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr Ile Met Pro Ala Ala 295 300 305			1027
caa gcc att gct gtc gat tca gtt cca agc act cag gtt ggt tcc ggt Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr Gln Val Gly Ser Gly 310 315 320 325			1075
att tct acg ctt ttc ctg ttc acc gac atc ggc att ggc tta ggc cca Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly Ile Gly Leu Gly Pro 330 335 340			1123
atc ctg ctg ggt gga ttg gtt gca gcg acc gga tac aac gtc atg tac Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly Tyr Asn Val Met Tyr 345 350 355			1171
gca gct ttg gcc gca gtg att gtt gtg gcg ggc gtg ctc tac ctg gtt Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly Val Leu Tyr Leu Val 360 365 370			1219
gct ttg ggt agg aaa gct agc cac taagtttagag cattttattg agc Ala Leu Gly Arg Lys Ala Ser His 375 380			1266

&lt;210&gt; 178

&lt;211&gt; 381

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 178

Val	Phe	Ile	Leu	Gly	Trp	Leu	Val	Asn	Leu	Thr	Gln	Tyr	Leu	Ser	Phe
1				5				10						15	

Tyr Phe Leu Ile Thr Val Met Ala Leu Tyr Ala Met Glu Ser Phe Ala

20					25					30					
Val	Ser	Glu	Ala	Ala	Val	Gly	Phe	Ala	Ala	Ser	Ser	Phe	Val	Ile	Gly
		35					40					45			
Ala	Thr	Val	Ala	Arg	Val	Phe	Ala	Gly	Trp	Thr	Ser	Asp	Arg	Phe	Gly
		50					55					60			
Lys	Lys	Gln	Ile	Leu	Leu	Ile	Phe	Val	Gly	Leu	Glu	Ala	Val	Ala	Ser
		65					70					75			80
Leu	Phe	Tyr	Ile	Pro	Ala	Ala	Ser	Leu	Pro	Ala	Leu	Val	Ala	Val	Arg
				85					90					95	
Phe	Val	His	Gly	Phe	Ser	Tyr	Ser	Leu	Ala	Ser	Thr	Ala	Val	Met	Ala
			100					105					110		
Leu	Val	Gln	Ser	Val	Ile	Pro	Ala	Ser	Arg	Arg	Ala	Glu	Gly	Thr	Gly
		115					120					125			
Tyr	Phe	Ala	Leu	Gly	Ser	Thr	Leu	Ala	Thr	Ala	Phe	Gly	Pro	Ala	Ile
		130					135					140			
Ala	Leu	Phe	Val	Ile	Asp	Asp	Phe	Asn	Tyr	Asn	Thr	Leu	Phe	Trp	Ile
				150					155					160	
Thr	Thr	Ala	Thr	Ser	Val	Phe	Gly	Leu	Ile	Leu	Thr	Val	Leu	Ile	Arg
				165					170					175	
Lys	Pro	Glu	Phe	Ile	Lys	Asn	Ala	Glu	His	Gly	Arg	Val	Lys	Pro	Val
			180					185					190		
Trp	Ser	Ile	Lys	Thr	Val	Val	His	Pro	Ser	Val	Met	Leu	Ile	Gly	Phe
			195				200					205			
Phe	Met	Leu	Ala	Val	Gly	Leu	Ala	Tyr	Ala	Gly	Val	Ile	Thr	Phe	Leu
			210				215					220			
Asn	Gly	Phe	Ala	Gln	Asp	Thr	Gly	Leu	Thr	Ala	Gly	Ala	Gly	Leu	Phe
				230					235					240	
Phe	Ile	Ala	Tyr	Ala	Val	Ala	Met	Leu	Val	Met	Arg	Phe	Phe	Leu	Gly
			245						250					255	
Arg	Ile	Gln	Asp	Lys	His	Gly	Asp	Asn	Pro	Val	Ile	Tyr	Phe	Gly	Leu
			260					265					270		
Ile	Ser	Phe	Ala	Leu	Ala	Leu	Gly	Leu	Met	Ala	Leu	Ala	Thr	Glu	Asp
			275				280					285			
Trp	His	Ile	Val	Leu	Ala	Gly	Ala	Leu	Thr	Gly	Leu	Gly	Tyr	Gly	Thr
			290				295					300			
Ile	Met	Pro	Ala	Ala	Gln	Ala	Ile	Ala	Val	Asp	Ser	Val	Pro	Ser	Thr
				310					315					320	
Gln	Val	Gly	Ser	Gly	Ile	Ser	Thr	Leu	Phe	Leu	Phe	Thr	Asp	Ile	Gly



	325		330		335
Ile Gly Leu Gly Pro Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly					
	340		345		350
Tyr Asn Val Met Tyr Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly					
	355		360		365
Val Leu Tyr Leu Val Ala Leu Gly Arg Lys Ala Ser His					
	370		375		380

<210> 179  
 <211> 914  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (1)..(891)  
 <223> FRXA01150

<400> 179

cca gct gcc tca cta cca gcg ctg gtt gct gtg cgt ttt gtt cac ggt	48
Pro Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg Phe Val His Gly	
1 5 10 15	
ttt tct tat tct ctt gct tcc acc gct gtg atg gca ctt gtg cag tcc	96
Phe Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala Leu Val Gln Ser	
20 25 30	
gtg att cct gca agc cgt agg gca gag ggc acc ggc tac ttc gcg ctc	144
Val Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly Tyr Phe Ala Leu	
35 40 45	
gga tcc aca ctg gct aca gct ttc ggc cca gca att gcg ctg ttt gtt	192
Gly Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile Ala Leu Phe Val	
50 55 60	
atc gat gac ttc aac tac aac acc ctg ttc tgg att acc act gcg acc	240
Ile Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile Thr Thr Ala Thr	
65 70 75 80	
agt gtt ttc ggc ctg atc ctc acc gtt ttg atc cgc aag ccg gag ttc	288
Ser Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg Lys Pro Glu Phe	
85 90 95	
att aag aat gcg gaa cac ggc aga gta aag cca gtc tgg tct atc aag	336
Ile Lys Asn Ala Glu His Gly Arg Val Lys Pro Val Trp Ser Ile Lys	
100 105 110	
act gtt gtg cac cca tcg gtc atg ctc att gga ttc ttc atg ctc gct	384
Thr Val Val His Pro Ser Val Met Leu Ile Gly Phe Phe Met Leu Ala	
115 120 125	
gtc gga ctg gct tac gca ggc gtg atc acc ttc ctc aac ggc ttc gcg	432
Val Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu Asn Gly Phe Ala	

130	135	140	
caa gac act ggc ctc acc gcc gga gcg ggt ctt ttc ttt atc gct tat			480
Gln Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe Phe Ile Ala Tyr			
145	150	155	160
gcg gtt gcg atg ctg gtc atg cgt ttc ttc ctt gga cgc att cag gac			528
Ala Val Ala Met Leu Val Met Arg Phe Phe Leu Gly Arg Ile Gln Asp			
	165	170	175
aaa cat ggt gac aac ccg gtt att tac ttc ggt ttg atc agc ttc gcc			576
Lys His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu Ile Ser Phe Ala			
	180	185	190
ctc gcg ctg ggg ctt atg gct ttg gcg act gaa gac tgg cac att gtt			624
Leu Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp Trp His Ile Val			
	195	200	205
ctc gct ggc gca ctc acc ggt ttg ggc tat ggc acc atc atg ccg gcc			672
Leu Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr Ile Met Pro Ala			
	210	215	220
gca caa gcc att gct gtc gat tca gtt cca agc act cag gtt ggt tcc			720
Ala Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr Gln Val Gly Ser			
	225	230	240
ggt att tct acg ctt ttc ctg ttc acc gac atc ggc att ggc tta ggc			768
Gly Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly Ile Gly Leu Gly			
	245	250	255
cca atc ctg ctg ggt gga ttg gtt gca gcg acc gga tac aac gtc atg			816
Pro Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly Tyr Asn Val Met			
	260	265	270
tac gca gct ttg gcc gca gtg att gtt gtg gcg ggc gtg ctc tac ctg			864
Tyr Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly Val Leu Tyr Leu			
	275	280	285
gtt gct ttg ggt agg aaa gct agc cac taagtttagag cattttattg			911
Val Ala Leu Gly Arg Lys Ala Ser His			
	290	295	
agc			914

&lt;210&gt; 180

&lt;211&gt; 297

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 180

Pro Ala Ala Ser Leu Pro Ala Leu Val Ala Val Arg Phe Val His Gly  
 1 5 10 15

Phe Ser Tyr Ser Leu Ala Ser Thr Ala Val Met Ala Leu Val Gln Ser  
 20 25 30

Val Ile Pro Ala Ser Arg Arg Ala Glu Gly Thr Gly Tyr Phe Ala Leu  
 35 40 45  
 Gly Ser Thr Leu Ala Thr Ala Phe Gly Pro Ala Ile Ala Leu Phe Val  
 50 55 60  
 Ile Asp Asp Phe Asn Tyr Asn Thr Leu Phe Trp Ile Thr Thr Ala Thr  
 65 70 75 80  
 Ser Val Phe Gly Leu Ile Leu Thr Val Leu Ile Arg Lys Pro Glu Phe  
 85 90 95  
 Ile Lys Asn Ala Glu His Gly Arg Val Lys Pro Val Trp Ser Ile Lys  
 100 105 110  
 Thr Val Val His Pro Ser Val Met Leu Ile Gly Phe Phe Met Leu Ala  
 115 120 125  
 Val Gly Leu Ala Tyr Ala Gly Val Ile Thr Phe Leu Asn Gly Phe Ala  
 130 135 140  
 Gln Asp Thr Gly Leu Thr Ala Gly Ala Gly Leu Phe Phe Ile Ala Tyr  
 145 150 155 160  
 Ala Val Ala Met Leu Val Met Arg Phe Phe Leu Gly Arg Ile Gln Asp  
 165 170 175  
 Lys His Gly Asp Asn Pro Val Ile Tyr Phe Gly Leu Ile Ser Phe Ala  
 180 185 190  
 Leu Ala Leu Gly Leu Met Ala Leu Ala Thr Glu Asp Trp His Ile Val  
 195 200 205  
 Leu Ala Gly Ala Leu Thr Gly Leu Gly Tyr Gly Thr Ile Met Pro Ala  
 210 215 220  
 Ala Gln Ala Ile Ala Val Asp Ser Val Pro Ser Thr Gln Val Gly Ser  
 225 230 235 240  
 Gly Ile Ser Thr Leu Phe Leu Phe Thr Asp Ile Gly Ile Gly Leu Gly  
 245 250 255  
 Pro Ile Leu Leu Gly Gly Leu Val Ala Ala Thr Gly Tyr Asn Val Met  
 260 265 270  
 Tyr Ala Ala Leu Ala Ala Val Ile Val Val Ala Gly Val Leu Tyr Leu  
 275 280 285  
 Val Ala Leu Gly Arg Lys Ala Ser His  
 290 295

&lt;210&gt; 181

&lt;211&gt; 1341

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(1318)

&lt;223&gt; RXN02964

&lt;400&gt; 181

ttttatatcc tagcaagggt gttgcatgat gcaataaacg tggtagtttg tgttcataac 60

aaaattgcat	gatgcaataa	tttcgattta	aaggagaaca	gtg	tcc	gta	gct	gaa	115
				Val	Ser	Val	Ala	Glu	
				1				5	

gaa	ggg	aaa	ctt	ttt	aca	cca	acg	ttt	gtc	atg	gga	tggt	ttt	gcc	aac	163
Glu	Gly	Lys	Leu	Phe	Thr	Pro	Thr	Phe	Val	Met	Gly	Trp	Phe	Ala	Asn	
			10						15					20		

ctt	ttc	cag	ttc	ctg	gtg	ttc	tac	ttc	ctc	atc	acc	acc	atg	gct	ttg	211
Leu	Phe	Gln	Phe	Leu	Val	Phe	Tyr	Phe	Leu	Ile	Thr	Thr	Met	Ala	Leu	
		25						30					35			

tac	gcc	atc	aag	gaa	ttt	caa	gcc	tct	gaa	gta	gaa	gct	ggc	ttc	gca	259
Tyr	Ala	Ile	Lys	Glu	Phe	Gln	Ala	Ser	Glu	Val	Glu	Ala	Gly	Phe	Ala	
		40					45					50				

tcc	agc	tca	att	gtt	atc	ggc	gca	gtc	ttt	tcc	agg	ttt	ttc	tcc	ggc	307
Ser	Ser	Ser	Ile	Val	Ile	Gly	Ala	Val	Phe	Ser	Arg	Phe	Phe	Ser	Gly	
	55					60				65						

tat	att	att	gac	cgt	ttt	ggg	cga	cgc	aag	att	gtg	ctc	atc	tca	gtc	355
Tyr	Ile	Ile	Asp	Arg	Phe	Gly	Arg	Arg	Lys	Ile	Val	Leu	Ile	Ser	Val	
70					75				80						85	

cta	gtc	act	acc	att	gcg	tgt	gcc	ttg	tac	ctt	ccc	atc	gaa	tca	ttg	403
Leu	Val	Thr	Thr	Ile	Ala	Cys	Ala	Leu	Tyr	Leu	Pro	Ile	Glu	Ser	Leu	
				90					95					100		

cca	ttg	cta	tac	gca	aac	agg	ttc	ctc	cac	ggg	gtt	gga	tac	gct	ttt	451
Pro	Leu	Leu	Tyr	Ala	Asn	Arg	Phe	Leu	His	Gly	Val	Gly	Tyr	Ala	Phe	
			105					110					115			

gct	gcc	acc	gcg	atc	atg	gca	atg	gtc	cag	gag	ctc	att	cca	gcg	tca	499
Ala	Ala	Thr	Ala	Ile	Met	Ala	Met	Val	Gln	Glu	Leu	Ile	Pro	Ala	Ser	
		120				125						130				

cga	cgt	tcc	gaa	ggg	act	ggg	tac	ctg	gca	ttg	ggc	act	acc	gtt	tct	547
Arg	Arg	Ser	Glu	Gly	Thr	Gly	Tyr	Leu	Ala	Leu	Gly	Thr	Thr	Val	Ser	
	135					140					145					

gca	gca	ctt	gga	cca	gcc	cta	gca	ctt	ttt	gtc	cta	gga	aca	ttt	gat	595
Ala	Ala	Leu	Gly	Pro	Ala	Leu	Ala	Leu	Phe	Val	Leu	Gly	Thr	Phe	Asp	
150					155					160					165	

tac	gac	atg	ctg	ttt	atc	gtg	gtc	ttg	gca	acc	tcg	gtc	atc	tct	ttg	643
Tyr	Asp	Met	Leu	Phe	Ile	Val	Val	Leu	Ala	Thr	Ser	Val	Ile	Ser	Leu	
			170						175					180		

atc	gcc	gtc	gtg	ttc	atg	tac	ttt	aag	acc	agc	gac	cct	gag	cct	tct	691
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Ile	Ala	Val	Val	Phe	Met	Tyr	Phe	Lys	Thr	Ser	Asp	Pro	Glu	Pro	Ser		
			185					190					195				
ggg	gaa	cca	gcc	aag	ttc	agc	ttc	aaa	tct	att	atg	aac	cca	aag	atc	739	
Gly	Glu	Pro	Ala	Lys	Phe	Ser	Phe	Lys	Ser	Ile	Met	Asn	Pro	Lys	Ile		
		200					205					210					
atc	ccc	atc	ggc	atc	ttt	atc	ttg	ctt	att	tgc	ttt	gct	tac	tct	ggc	787	
Ile	Pro	Ile	Gly	Ile	Phe	Ile	Leu	Leu	Ile	Cys	Phe	Ala	Tyr	Ser	Gly		
	215					220				225							
gtc	att	gcc	tac	atc	aac	gca	ttt	gct	gaa	gaa	cgc	gat	ctg	att	acg	835	
Val	Ile	Ala	Tyr	Ile	Asn	Ala	Phe	Ala	Glu	Glu	Arg	Asp	Leu	Ile	Thr		
230					235				240						245		
ggc	gct	gga	ttg	ttc	ttc	att	gcc	tac	gca	gta	tca	atg	ttt	gtg	atg	883	
Gly	Ala	Gly	Leu	Phe	Phe	Ile	Ala	Tyr	Ala	Val	Ser	Met	Phe	Val	Met		
			250					255						260			
cgc	agc	ttc	ctt	ggc	aaa	ctg	cag	gac	cgt	cgc	gga	gac	aac	gtc	gtt	931	
Arg	Ser	Phe	Leu	Gly	Lys	Leu	Gln	Asp	Arg	Arg	Gly	Asp	Asn	Val	Val		
		265					270						275				
att	tac	ttt	gga	ttg	ttc	ttc	ttc	gtt	att	tcc	ttg	acg	att	ttg	tcc	979	
Ile	Tyr	Phe	Gly	Leu	Phe	Phe	Phe	Val	Ile	Ser	Leu	Thr	Ile	Leu	Ser		
	280					285						290					
ttt	gcc	act	tcc	aac	tgg	cac	gtt	gtg	ttg	tcc	gga	gtc	att	gca	ggt	1027	
Phe	Ala	Thr	Ser	Asn	Trp	His	Val	Val	Leu	Ser	Gly	Val	Ile	Ala	Gly		
	295				300						305						
ctg	gga	tac	ggc	act	ttg	atg	cca	gca	gtg	cag	tcc	atc	gct	gtt	ggt	1075	
Leu	Gly	Tyr	Gly	Thr	Leu	Met	Pro	Ala	Val	Gln	Ser	Ile	Ala	Val	Gly		
310					315					320					325		
gta	gta	gac	aaa	acc	gaa	ttc	ggc	acg	gcc	ttc	tcc	act	ttg	ttc	ctg	1123	
Val	Val	Asp	Lys	Thr	Glu	Phe	Gly	Thr	Ala	Phe	Ser	Thr	Leu	Phe	Leu		
			330					335						340			
ttt	gtg	gac	tta	ggc	ttt	ggc	ttt	gga	cct	att	atc	ctg	gga	gca	gtt	1171	
Phe	Val	Asp	Leu	Gly	Phe	Gly	Phe	Gly	Pro	Ile	Ile	Leu	Gly	Ala	Val		
		345					350						355				
tct	gcg	gca	att	ggc	ttc	gga	cct	atg	tat	gca	gca	ctg	gca	ggc	gtg	1219	
Ser	Ala	Ala	Ile	Gly	Phe	Gly	Pro	Met	Tyr	Ala	Ala	Leu	Ala	Gly	Val		
	360					365						370					
ggc	gtg	att	gcc	gga	atc	ttc	tac	ctg	ttc	aca	cac	gct	cgc	acc	gat	1267	
Gly	Val	Ile	Ala	Gly	Ile	Phe	Tyr	Leu	Phe	Thr	His	Ala	Arg	Thr	Asp		
	375					380					385						
cga	gct	aag	aat	ggc	ttt	gtt	aaa	cac	cca	gag	cct	gtc	gct	tta	gtt	1315	
Arg	Ala	Lys	Asn	Gly	Phe	Val	Lys	His	Pro	Glu	Pro	Val	Ala	Leu	Val		
390				395						400					405		
agc	tagttcttttc	agctttccct	ccc													1341	
Ser																	

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 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 182  
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           20                  25                  30  
 Thr Thr Met Ala Leu Tyr Ala Ile Lys Glu Phe Gln Ala Ser Glu Val  
           35                  40                  45  
 Glu Ala Gly Phe Ala Ser Ser Ser Ile Val Ile Gly Ala Val Phe Ser  
       50                  55                  60  
 Arg Phe Phe Ser Gly Tyr Ile Ile Asp Arg Phe Gly Arg Arg Lys Ile  
   65                  70                  75                  80  
 Val Leu Ile Ser Val Leu Val Thr Thr Ile Ala Cys Ala Leu Tyr Leu  
           85                  90                  95  
 Pro Ile Glu Ser Leu Pro Leu Leu Tyr Ala Asn Arg Phe Leu His Gly  
           100                  105                  110  
 Val Gly Tyr Ala Phe Ala Ala Thr Ala Ile Met Ala Met Val Gln Glu  
       115                  120                  125  
 Leu Ile Pro Ala Ser Arg Arg Ser Glu Gly Thr Gly Tyr Leu Ala Leu  
       130                  135                  140  
 Gly Thr Thr Val Ser Ala Ala Leu Gly Pro Ala Leu Ala Leu Phe Val  
   145                  150                  155                  160  
 Leu Gly Thr Phe Asp Tyr Asp Met Leu Phe Ile Val Val Leu Ala Thr  
           165                  170                  175  
 Ser Val Ile Ser Leu Ile Ala Val Val Phe Met Tyr Phe Lys Thr Ser  
           180                  185                  190  
 Asp Pro Glu Pro Ser Gly Glu Pro Ala Lys Phe Ser Phe Lys Ser Ile  
       195                  200                  205  
 Met Asn Pro Lys Ile Ile Pro Ile Gly Ile Phe Ile Leu Leu Ile Cys  
       210                  215                  220  
 Phe Ala Tyr Ser Gly Val Ile Ala Tyr Ile Asn Ala Phe Ala Glu Glu  
   225                  230                  235                  240  
 Arg Asp Leu Ile Thr Gly Ala Gly Leu Phe Phe Ile Ala Tyr Ala Val  
           245                  250                  255

Ser Met Phe Val Met Arg Ser Phe Leu Gly Lys Leu Gln Asp Arg Arg  
 260 265 270  
 Gly Asp Asn Val Val Ile Tyr Phe Gly Leu Phe Phe Phe Val Ile Ser  
 275 280 285  
 Leu Thr Ile Leu Ser Phe Ala Thr Ser Asn Trp His Val Val Leu Ser  
 290 295 300  
 Gly Val Ile Ala Gly Leu Gly Tyr Gly Thr Leu Met Pro Ala Val Gln  
 305 310 315 320  
 Ser Ile Ala Val Gly Val Val Asp Lys Thr Glu Phe Gly Thr Ala Phe  
 325 330 335  
 Ser Thr Leu Phe Leu Phe Val Asp Leu Gly Phe Gly Phe Gly Pro Ile  
 340 345 350  
 Ile Leu Gly Ala Val Ser Ala Ala Ile Gly Phe Gly Pro Met Tyr Ala  
 355 360 365  
 Ala Leu Ala Gly Val Gly Val Ile Ala Gly Ile Phe Tyr Leu Phe Thr  
 370 375 380  
 His Ala Arg Thr Asp Arg Ala Lys Asn Gly Phe Val Lys His Pro Glu  
 385 390 395 400  
 Pro Val Ala Leu Val Ser  
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<220>  
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 <223> FRXA02116

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 Val Ser Val Ala Glu  
 1 5  
 gaa ggg aaa ctt ttt aca cca acg ttt gtc atg gga tgg ttt gcc aac 163  
 Glu Gly Lys Leu Phe Thr Pro Thr Phe Val Met Gly Trp Phe Ala Asn  
 10 15 20  
 ctt ttc cag ttc ctg gtg ttc tac ttc ctc atc acc acc atg gct ttg 211  
 Leu Phe Gln Phe Leu Val Phe Tyr Phe Leu Ile Thr Thr Met Ala Leu  
 25 30 35  
 tac gcc atc aag gaa ttt caa gcc tct gaa gta gaa gct ggc ttc gca 259



Tyr	Ala	Ile	Lys	Glu	Phe	Gln	Ala	Ser	Glu	Val	Glu	Ala	Gly	Phe	Ala		
	40						45					50					
tcc	agc	tca	att	gtt	atc	ggc	gca	gtc	ttt	tcc	agg	ttt	ttc	tcc	ggc	307	
Ser	Ser	Ser	Ile	Val	Ile	Gly	Ala	Val	Phe	Ser	Arg	Phe	Phe	Ser	Gly		
	55					60				65							
tat	att	att	gac	cgt	ttt	ggc	cga	cgc	aag	att	gtg	ctc	atc	tca	gtc	355	
Tyr	Ile	Ile	Asp	Arg	Phe	Gly	Arg	Arg	Lys	Ile	Val	Leu	Ile	Ser	Val		
70					75					80					85		
cta	gtc	act	acc	att	gcg	tgt	gcc	ttg	tac	ctt	ccc	atc	gaa	tca	ttg	403	
Leu	Val	Thr	Thr	Ile	Ala	Cys	Ala	Leu	Tyr	Leu	Pro	Ile	Glu	Ser	Leu		
				90				95						100			
cca	ttg	cta	tac	gca	aac	agg	ttc	ctc	cac	ggc	gtt	gga	tac	gct	ttt	451	
Pro	Leu	Leu	Tyr	Ala	Asn	Arg	Phe	Leu	His	Gly	Val	Gly	Tyr	Ala	Phe		
			105				110						115				
gct	gcc	acc	gcg	atc	atg	gca	atg	gtc	cag	gag	ctc	att	cca	gcg	tca	499	
Ala	Ala	Thr	Ala	Ile	Met	Ala	Met	Val	Gln	Glu	Leu	Ile	Pro	Ala	Ser		
		120				125						130					
cga	cgt	tcc	gaa	ggc	act	ggc	tac	ctg	gca	ttg	ggc	act	acc	gtt	tct	547	
Arg	Arg	Ser	Glu	Gly	Thr	Gly	Tyr	Leu	Ala	Leu	Gly	Thr	Thr	Val	Ser		
	135					140					145						
gca	gca	ctt	gga	cca	gcc	cta	gca	ctt	ttt	gtc	cta	gga	aca	ttt	gat	595	
Ala	Ala	Leu	Gly	Pro	Ala	Leu	Ala	Leu	Phe	Val	Leu	Gly	Thr	Phe	Asp		
150					155					160					165		
tac	gac	atg	ctg	ttt	atc	gtg	gtc	ttg	gca	acc	tcg	gtc	atc	tct	ttg	643	
Tyr	Asp	Met	Leu	Phe	Ile	Val	Val	Leu	Ala	Thr	Ser	Val	Ile	Ser	Leu		
				170				175						180			
atc	gcc	gtc	gtg	ttc	atg	tac	ttt	aag	acc	agc	gac	cct	gag	cct	tct	691	
Ile	Ala	Val	Val	Phe	Met	Tyr	Phe	Lys	Thr	Ser	Asp	Pro	Glu	Pro	Ser		
			185					190					195				
ggg	gaa	cca	gcc	aag	ttc	agc	ttc	aaa	tct	att	atg	aac	cca	aag	atc	739	
Gly	Glu	Pro	Ala	Lys	Phe	Ser	Phe	Lys	Ser	Ile	Met	Asn	Pro	Lys	Ile		
	200						205					210					
atc	ccc	atc	ggc	atc	ttt	atc	ttg	ctt	att	tgc	ttt	gct	tac	tct	ggc	787	
Ile	Pro	Ile	Gly	Ile	Phe	Ile	Leu	Leu	Ile	Cys	Phe	Ala	Tyr	Ser	Gly		
	215					220					225						
gtc	att	gcc	tac	atc	aac	gca	ttt	gct	gaa	gaa	cgc	gat	ctg	att	acg	835	
Val	Ile	Ala	Tyr	Ile	Asn	Ala	Phe	Ala	Glu	Glu	Arg	Asp	Leu	Ile	Thr		
230					235					240					245		
ggc	gct	gga	ttg	ttc	ttc	att	gcc	tac	gca	gta	tca	atg	ttt	gtg	atg	883	
Gly	Ala	Gly	Leu	Phe	Phe	Ile	Ala	Tyr	Ala	Val	Ser	Met	Phe	Val	Met		
				250					255					260			
cgc	agc	ttc	ctt	ggc	aaa	ctg	cag	gac	cgt	cgc	gga	gac	aac	gtc	gtt	931	
Arg	Ser	Phe	Leu	Gly	Lys	Leu	Gln	Asp	Arg	Arg	Gly	Asp	Asn	Val	Val		

265                      270                      275  
 att tac ttt gga ttg ttc ttc ttc gtt att tcc ttg acg att ttg tcc 979  
 Ile Tyr Phe Gly Leu Phe Phe Phe Val Ile Ser Leu Thr Ile Leu Ser  
           280                      285                      290  
  
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 Phe Ala Thr Ser Asn Trp His Val Val  
           295                      300  
  
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 <213> *Corynebacterium glutamicum*  
  
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           20                      25                      30  
 Thr Thr Met Ala Leu Tyr Ala Ile Lys Glu Phe Gln Ala Ser Glu Val  
           35                      40                      45  
 Glu Ala Gly Phe Ala Ser Ser Ser Ile Val Ile Gly Ala Val Phe Ser  
           50                      55                      60  
 Arg Phe Phe Ser Gly Tyr Ile Ile Asp Arg Phe Gly Arg Arg Lys Ile  
   65                      70                      75                      80  
 Val Leu Ile Ser Val Leu Val Thr Thr Ile Ala Cys Ala Leu Tyr Leu  
           85                      90                      95  
 Pro Ile Glu Ser Leu Pro Leu Leu Tyr Ala Asn Arg Phe Leu His Gly  
           100                      105                      110  
 Val Gly Tyr Ala Phe Ala Ala Thr Ala Ile Met Ala Met Val Gln Glu  
           115                      120                      125  
 Leu Ile Pro Ala Ser Arg Arg Ser Glu Gly Thr Gly Tyr Leu Ala Leu  
           130                      135                      140  
 Gly Thr Thr Val Ser Ala Ala Leu Gly Pro Ala Leu Ala Leu Phe Val  
 145                      150                      155                      160  
 Leu Gly Thr Phe Asp Tyr Asp Met Leu Phe Ile Val Val Leu Ala Thr  
           165                      170                      175  
 Ser Val Ile Ser Leu Ile Ala Val Val Phe Met Tyr Phe Lys Thr Ser  
           180                      185                      190  
 Asp Pro Glu Pro Ser Gly Glu Pro Ala Lys Phe Ser Phe Lys Ser Ile  
           195                      200                      205  
 Met Asn Pro Lys Ile Ile Pro Ile Gly Ile Phe Ile Leu Leu Ile Cys

210	215	220
Phe Ala Tyr Ser Gly Val Ile Ala Tyr Ile Asn Ala Phe Ala Glu Glu		
225	230	235 240
Arg Asp Leu Ile Thr Gly Ala Gly Leu Phe Phe Ile Ala Tyr Ala Val		
	245	250 255
Ser Met Phe Val Met Arg Ser Phe Leu Gly Lys Leu Gln Asp Arg Arg		
	260	265 270
Gly Asp Asn Val Val Ile Tyr Phe Gly Leu Phe Phe Phe Val Ile Ser		
	275	280 285
Leu Thr Ile Leu Ser Phe Ala Thr Ser Asn Trp His Val Val		
290	295	300

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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(568)  
 <223> RXA00858

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 tcttaaattg tctaaccaag aaccggaggt tctttttgtc atg gaa gta aac tta 115  
 Met Glu Val Asn Leu 5  
 gcc aca tgg cta atc act atc gca gtg att gct ggc ttc ttc att ttc 163  
 Ala Thr Trp Leu Ile Thr Ile Ala Val Ile Ala Gly Phe Phe Ile Phe 20  
 gat ttc tat tcc cac gtc cgc acc cca cac gag ccc act atc aaa gaa 211  
 Asp Phe Tyr Ser His Val Arg Thr Pro His Glu Pro Thr Ile Lys Glu 35  
 tcc gca tgg tgg agc ctc ttc tac gta gcc ctc gcc tgt gtt ttc ggc 259  
 Ser Ala Trp Trp Ser Leu Phe Tyr Val Ala Leu Ala Cys Val Phe Gly 50  
 gtg ttc ctc tgg ttt gct tgg ggc gag cca ggt aac cca cac cag cac 307  
 Val Phe Leu Trp Phe Ala Trp Gly Glu Pro Gly Asn Pro His Gln His 65  
 ggc att gag ttc ttc acc ggt tac gtg aca gag aag gcg ttg agt gtt 355  
 Gly Ile Glu Phe Phe Thr Gly Tyr Val Thr Glu Lys Ala Leu Ser Val 85  
 gat aac ctc ttc atc ttc gcg ctg atc atg ggt tct ttc aag att cct 403  
 Asp Asn Leu Phe Ile Phe Ala Leu Ile Met Gly Ser Phe Lys Ile Pro

	90	95	100	
cgc aag tac cag cag aag gtt ctg ctc atc ggt atc gcg ctg gca ctg				451
Arg Lys Tyr Gln Gln Lys Val Leu Leu Ile Gly Ile Ala Leu Ala Leu				
	105	110	115	
gtc ttc cgc ctg gca ttc atc ctc gca ggt gct gca gtt atc gaa gcc				499
Val Phe Arg Leu Ala Phe Ile Leu Ala Gly Ala Ala Val Ile Glu Ala				
	120	125	130	
tgg tcc gat gtc ttc tac atc ttc tcc atc tgg ctg atc tac acc gct				547
Trp Ser Asp Val Phe Tyr Ile Phe Ser Ile Trp Leu Ile Tyr Thr Ala				
	135	140	145	
gtg aag gct cct gtg cac gag				568
Val Lys Ala Pro Val His Glu				
	150	155		

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 <211> 156  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 186  
 Met Glu Val Asn Leu Ala Thr Trp Leu Ile Thr Ile Ala Val Ile Ala  
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 Gly Phe Phe Ile Phe Asp Phe Tyr Ser His Val Arg Thr Pro His Glu  
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 Pro Thr Ile Lys Glu Ser Ala Trp Trp Ser Leu Phe Tyr Val Ala Leu  
 35 40 45  
 Ala Cys Val Phe Gly Val Phe Leu Trp Phe Ala Trp Gly Glu Pro Gly  
 50 55 60  
 Asn Pro His Gln His Gly Ile Glu Phe Phe Thr Gly Tyr Val Thr Glu  
 65 70 75 80  
 Lys Ala Leu Ser Val Asp Asn Leu Phe Ile Phe Ala Leu Ile Met Gly  
 85 90 95  
 Ser Phe Lys Ile Pro Arg Lys Tyr Gln Gln Lys Val Leu Leu Ile Gly  
 100 105 110  
 Ile Ala Leu Ala Leu Val Phe Arg Leu Ala Phe Ile Leu Ala Gly Ala  
 115 120 125  
 Ala Val Ile Glu Ala Trp Ser Asp Val Phe Tyr Ile Phe Ser Ile Trp  
 130 135 140  
 Leu Ile Tyr Thr Ala Val Lys Ala Pro Val His Glu  
 145 150 155

<210> 187

<211> 975  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(952)  
 <223> RXA02305

<400> 187

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caaacgatga cttcgatccc gaaaagtgga ggaacatgta atg cca gcc ttt gag 115
                                         Met Pro Ala Phe Glu
                                         1                               5

gca atg cca gga atg ccg tat tgg atc gac ctg tcc acc tcg gac att 163
Ala Met Pro Gly Met Pro Tyr Trp Ile Asp Leu Ser Thr Ser Asp Ile
                        10                        15                        20

gca aaa tct gca cac ttc tac gaa aac gtt ctc ggc tgg gaa att gaa 211
Ala Lys Ser Ala His Phe Tyr Glu Asn Val Leu Gly Trp Glu Ile Glu
                        25                        30                        35

gaa gtc aac gat ggc tac cgc atg gct cgt ctg cag gga cta ccc gtg 259
Glu Val Asn Asp Gly Tyr Arg Met Ala Arg Leu Gln Gly Leu Pro Val
                        40                        45                        50

gca ggg ctg atc gat cag cgc ggt gaa tca agc atc ccg gat acc tgg 307
Ala Gly Leu Ile Asp Gln Arg Gly Glu Ser Ser Ile Pro Asp Thr Trp
                        55                        60                        65

att acc tac ttc ctc tcc tac gat ctg gat gcc act gca aag aag atc 355
Ile Thr Tyr Phe Leu Ser Tyr Asp Leu Asp Ala Thr Ala Lys Lys Ile
                        70                        75                        80                        85

gca gaa ctg ggt gga cga att ctg gcc gag cca act gac gtg cac ttg 403
Ala Glu Leu Gly Gly Arg Ile Leu Ala Glu Pro Thr Asp Val His Leu
                        90                        95                        100

gga cgc atg atc cta gct gtt gat act gcc ggc gca ctg ttc ggc gtt 451
Gly Arg Met Ile Leu Ala Val Asp Thr Ala Gly Ala Leu Phe Gly Val
                        105                        110                        115

att gag cca ggc agc gag gaa tca ttc gtc gct gct ggt gaa cca ggc 499
Ile Glu Pro Gly Ser Glu Glu Ser Phe Val Ala Ala Gly Glu Pro Gly
                        120                        125                        130

aca tcc gtg tgg cat gaa ctc acc act gtc tcc aaa tat tcc gaa gct 547
Thr Ser Val Trp His Glu Leu Thr Thr Val Ser Lys Tyr Ser Glu Ala
                        135                        140                        145

atc gat ttc tac ggt gag ctg ttc act tgg aca acc tct gaa atg gct 595
Ile Asp Phe Tyr Gly Glu Leu Phe Thr Trp Thr Thr Ser Glu Met Ala
150                        155                        160                        165

agt gct gaa gac gat agt ttc cgc tac acc acc gca ttg gct gac ggt 643
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Ser Ala Glu Asp Asp Ser Phe Arg Tyr Thr Thr Ala Leu Ala Asp Gly  
 170 175 180  
 tcc gcc ttt gct gga att ttt gat gcc aaa ggc cac ttc cca cct cag 691  
 Ser Ala Phe Ala Gly Ile Phe Asp Ala Lys Gly His Phe Pro Pro Gln  
 185 190 195  
 gtt cca agc ttc tgg cag tcc tac ctt ggc gtg ctc aac gcc gat gat 739  
 Val Pro Ser Phe Trp Gln Ser Tyr Leu Gly Val Leu Asn Ala Asp Asp  
 200 205 210  
 gct gca gcg aag gcc aag gaa ttt ggt ggc gat gtt att cgt aag cca 787  
 Ala Ala Ala Lys Ala Lys Glu Phe Gly Gly Asp Val Ile Arg Lys Pro  
 215 220 225  
 tgg gac tca gaa ttt ggc cgc atg gtt ctc atc tct gat tcc act ggt 835  
 Trp Asp Ser Glu Phe Gly Arg Met Val Leu Ile Ser Asp Ser Thr Gly  
 230 235 240 245  
 gcc aca att acc ttg tgt gaa gta gag gaa tac gtc gag gaa gca gca 883  
 Ala Thr Ile Thr Leu Cys Glu Val Glu Glu Tyr Val Glu Glu Ala Ala  
 250 255 260  
 gaa ggc gat gat ctc ttc gac atc gat ctc agt gct ttc gaa gag cag 931  
 Glu Gly Asp Asp Leu Phe Asp Ile Asp Leu Ser Ala Phe Glu Glu Gln  
 265 270 275  
 ttc cgc aag caa gaa gga cag taatcctaca gcgccatgga gga 975  
 Phe Arg Lys Gln Glu Gly Gln  
 280

&lt;210&gt; 188

&lt;211&gt; 284

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 188

Met Pro Ala Phe Glu Ala Met Pro Gly Met Pro Tyr Trp Ile Asp Leu  
 1 5 10 15  
 Ser Thr Ser Asp Ile Ala Lys Ser Ala His Phe Tyr Glu Asn Val Leu  
 20 25 30  
 Gly Trp Glu Ile Glu Glu Val Asn Asp Gly Tyr Arg Met Ala Arg Leu  
 35 40 45  
 Gln Gly Leu Pro Val Ala Gly Leu Ile Asp Gln Arg Gly Glu Ser Ser  
 50 55 60  
 Ile Pro Asp Thr Trp Ile Thr Tyr Phe Leu Ser Tyr Asp Leu Asp Ala  
 65 70 75 80  
 Thr Ala Lys Lys Ile Ala Glu Leu Gly Gly Arg Ile Leu Ala Glu Pro  
 85 90 95  
 Thr Asp Val His Leu Gly Arg Met Ile Leu Ala Val Asp Thr Ala Gly

100	105	110
Ala Leu Phe Gly Val Ile Glu Pro Gly Ser Glu Glu Ser Phe Val Ala		
115	120	125
Ala Gly Glu Pro Gly Thr Ser Val Trp His Glu Leu Thr Thr Val Ser		
130	135	140
Lys Tyr Ser Glu Ala Ile Asp Phe Tyr Gly Glu Leu Phe Thr Trp Thr		
145	150	155
Thr Ser Glu Met Ala Ser Ala Glu Asp Asp Ser Phe Arg Tyr Thr Thr		
165	170	175
Ala Leu Ala Asp Gly Ser Ala Phe Ala Gly Ile Phe Asp Ala Lys Gly		
180	185	190
His Phe Pro Pro Gln Val Pro Ser Phe Trp Gln Ser Tyr Leu Gly Val		
195	200	205
Leu Asn Ala Asp Asp Ala Ala Ala Lys Ala Lys Glu Phe Gly Gly Asp		
210	215	220
Val Ile Arg Lys Pro Trp Asp Ser Glu Phe Gly Arg Met Val Leu Ile		
225	230	235
Ser Asp Ser Thr Gly Ala Thr Ile Thr Leu Cys Glu Val Glu Glu Tyr		
245	250	255
Val Glu Glu Ala Ala Glu Gly Asp Asp Leu Phe Asp Ile Asp Leu Ser		
260	265	270
Ala Phe Glu Glu Gln Phe Arg Lys Gln Glu Gly Gln		
275	280	

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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(925)  
 <223> RXA00084

<400> 189  
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 Met Ser Thr Ala Leu  
 1 5  
 ccc gat cag ctc aag tgg gaa tac agt gcc ttc ccc gtg cag atc tcg 163  
 Pro Asp Gln Leu Lys Trp Glu Tyr Ser Ala Phe Pro Val Gln Ile Ser  
 10 15 20



cag aag caa cgg ctt agt ccc ggc ttc atg cgg atc acc gtc act ggt Gln Lys Gln Arg Leu Ser Pro Gly Phe Met Arg Ile Thr Val Thr Gly 25 30 35	211
gac aag ctc cga ttc ttt ggc cag tgg ggt ttg gac caa cgc atc aaa Asp Lys Leu Arg Phe Phe Gly Gln Trp Gly Leu Asp Gln Arg Ile Lys 40 45 50	259
ctg atc att cca agc ccg gct ggg aac atc cca gat ttc gga att ctc Leu Ile Ile Pro Ser Pro Ala Gly Asn Ile Pro Asp Phe Gly Ile Leu 55 60 65	307
gac gaa ccc act ccc cca ccg aca acg tgg ctt cct cgt gct aag tct Asp Glu Pro Thr Pro Pro Pro Thr Thr Trp Leu Pro Arg Ala Lys Ser 70 75 80 85	355
ttt cca gcg gac caa cga ccg atc ttg cgc acc tac acc cca tct gcg Phe Pro Ala Asp Gln Arg Pro Ile Leu Arg Thr Tyr Thr Pro Ser Ala 90 95 100	403
gtc cga ccc gaa cta tgc gaa gta gac att gat atc tat ctt cac aac Val Arg Pro Glu Leu Cys Glu Val Asp Ile Asp Ile Tyr Leu His Asn 105 110 115	451
cct tcg gga cca gta tcc aga tgg gca aag aac tgc agt gtt gac gat Pro Ser Gly Pro Val Ser Arg Trp Ala Lys Asn Cys Ser Val Asp Asp 120 125 130	499
gaa cta atc atc acc ggc cct gac gta cgc gca gga gaa acc ggc tac Glu Leu Ile Ile Thr Gly Pro Asp Val Arg Ala Gly Glu Thr Gly Tyr 135 140 145	547
gga atc acc tat cat ccg act tct gcg atc gat cgc ctc tgt ctc atc Gly Ile Thr Tyr His Pro Thr Ser Ala Ile Asp Arg Leu Cys Leu Ile 150 155 160 165	595
ggc gat tgt gca tca gct ccc gcg atc gca aat atc gtc aat caa tca Gly Asp Cys Ala Ser Ala Pro Ala Ile Ala Asn Ile Val Asn Gln Ser 170 175 180	643
aaa gta cct act acg gtt ttc ctc cac gta gac agc cta gaa gat gat Lys Val Pro Thr Thr Val Phe Leu His Val Asp Ser Leu Glu Asp Asp 185 190 195	691
gta ttg atc gcc gat agc tcc acc aag ctc act ttc gaa gac atc gac Val Leu Ile Ala Asp Ser Ser Thr Lys Leu Thr Phe Glu Asp Ile Asp 200 205 210	739
gct tac aaa gca aag gtc ttc caa tgg gct tca gcc aat gca gca gat Ala Tyr Lys Ala Lys Val Phe Gln Trp Ala Ser Ala Asn Ala Ala Asp 215 220 225	787
cct tca gta cac ttc tgg atc gcc ggt gaa act agc atg gtg cgc ttc Pro Ser Val His Phe Trp Ile Ala Gly Glu Thr Ser Met Val Arg Phe 230 235 240 245	835
att cgc aaa gaa cta atc aac agc tac cga gtt gat tcc tca cga atc	883

Ile Arg Lys Glu Leu Ile Asn Ser Tyr Arg Val Asp Ser Ser Arg Ile  
                   250                  255                  260

act ttc ctc ggc tac tgg aaa tac ggc cga cga acc gta gac                  925  
 Thr Phe Leu Gly Tyr Trp Lys Tyr Gly Arg Arg Thr Val Asp  
                   265                  270                  275

tagcttttcag attcagaccc cag                  948

<210> 190

<211> 275

<212> PRT

<213> Corynebacterium glutamicum

<400> 190

Met Ser Thr Ala Leu Pro Asp Gln Leu Lys Trp Glu Tyr Ser Ala Phe  
   1                  5                  10                  15

Pro Val Gln Ile Ser Gln Lys Gln Arg Leu Ser Pro Gly Phe Met Arg  
                   20                  25                  30

Ile Thr Val Thr Gly Asp Lys Leu Arg Phe Phe Gly Gln Trp Gly Leu  
                   35                  40                  45

Asp Gln Arg Ile Lys Leu Ile Ile Pro Ser Pro Ala Gly Asn Ile Pro  
                   50                  55                  60

Asp Phe Gly Ile Leu Asp Glu Pro Thr Pro Pro Pro Thr Thr Trp Leu  
   65                  70                  75                  80

Pro Arg Ala Lys Ser Phe Pro Ala Asp Gln Arg Pro Ile Leu Arg Thr  
                   85                  90                  95

Tyr Thr Pro Ser Ala Val Arg Pro Glu Leu Cys Glu Val Asp Ile Asp  
                   100                  105                  110

Ile Tyr Leu His Asn Pro Ser Gly Pro Val Ser Arg Trp Ala Lys Asn  
                   115                  120                  125

Cys Ser Val Asp Asp Glu Leu Ile Ile Thr Gly Pro Asp Val Arg Ala  
   130                  135                  140

Gly Glu Thr Gly Tyr Gly Ile Thr Tyr His Pro Thr Ser Ala Ile Asp  
  145                  150                  155                  160

Arg Leu Cys Leu Ile Gly Asp Cys Ala Ser Ala Pro Ala Ile Ala Asn  
                   165                  170                  175

Ile Val Asn Gln Ser Lys Val Pro Thr Thr Val Phe Leu His Val Asp  
                   180                  185                  190

Ser Leu Glu Asp Asp Val Leu Ile Ala Asp Ser Ser Thr Lys Leu Thr  
                   195                  200                  205

Phe Glu Asp Ile Asp Ala Tyr Lys Ala Lys Val Phe Gln Trp Ala Ser  
   210                  215                  220

Ala Asn Ala Ala Asp Pro Ser Val His Phe Trp Ile Ala Gly Glu Thr  
225 230 235 240

Ser Met Val Arg Phe Ile Arg Lys Glu Leu Ile Asn Ser Tyr Arg Val  
245 250 255

Asp Ser Ser Arg Ile Thr Phe Leu Gly Tyr Trp Lys Tyr Gly Arg Arg  
260 265 270

Thr Val Asp  
275

<210> 191

<211> 468

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(445)

<223> RXA00843

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tttgaataat catggaacaa accttagtag gctcaacggt atg aaa gtc acg att 115  
Met Lys Val Thr Ile  
1 5

ttc cat aat ccg cgt tgt tcc aca tcc aga aat acc ctc gct tac ctc 163  
Phe His Asn Pro Arg Cys Ser Thr Ser Arg Asn Thr Leu Ala Tyr Leu  
10 15 20

cgc gac aag gac att gag cct gaa att gtt cag tat ctc aaa gac acg 211  
Arg Asp Lys Asp Ile Glu Pro Glu Ile Val Gln Tyr Leu Lys Asp Thr  
25 30 35

ccc acc gct tcc gag ctc aaa gaa cta ttc aat acg ctg gga att cca 259  
Pro Thr Ala Ser Glu Leu Lys Glu Leu Phe Asn Thr Leu Gly Ile Pro  
40 45 50

gtc cac gac ggc atc aga acc cgc gaa gct gag tac aca gaa ctg ggc 307  
Val His Asp Gly Ile Arg Thr Arg Glu Ala Glu Tyr Thr Glu Leu Gly  
55 60 65

ctg tca cca gaa aca cct gaa act gag ctt atc gac gcc atc gtt gcc 355  
Leu Ser Pro Glu Thr Pro Glu Thr Glu Leu Ile Asp Ala Ile Val Ala  
70 75 80 85

cat ccc agg ctc ctt cag cgt ccg atc gtg gtg acg gcc aaa ggc gcg 403  
His Pro Arg Leu Leu Gln Arg Pro Ile Val Val Thr Ala Lys Gly Ala  
90 95 100

cgc att gcg cgc ccc aaa atc gac gtc att gac agc atc ttg 445  
Arg Ile Ala Arg Pro Lys Ile Asp Val Ile Asp Ser Ile Leu

105

110

115

tgacaacatt ttgtagagca acc

468

&lt;210&gt; 192

&lt;211&gt; 115

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 192

Met	Lys	Val	Thr	Ile	Phe	His	Asn	Pro	Arg	Cys	Ser	Thr	Ser	Arg	Asn
1				5					10					15	

Thr	Leu	Ala	Tyr	Leu	Arg	Asp	Lys	Asp	Ile	Glu	Pro	Glu	Ile	Val	Gln
			20					25						30	

Tyr	Leu	Lys	Asp	Thr	Pro	Thr	Ala	Ser	Glu	Leu	Lys	Glu	Leu	Phe	Asn
		35					40					45			

Thr	Leu	Gly	Ile	Pro	Val	His	Asp	Gly	Ile	Arg	Thr	Arg	Glu	Ala	Glu
	50					55					60				

Tyr	Thr	Glu	Leu	Gly	Leu	Ser	Pro	Glu	Thr	Pro	Glu	Thr	Glu	Leu	Ile
65					70					75					80

Asp	Ala	Ile	Val	Ala	His	Pro	Arg	Leu	Leu	Gln	Arg	Pro	Ile	Val	Val
				85						90				95	

Thr	Ala	Lys	Gly	Ala	Arg	Ile	Ala	Arg	Pro	Lys	Ile	Asp	Val	Ile	Asp
			100					105					110		

Ser	Ile	Leu
		115

&lt;210&gt; 193

&lt;211&gt; 432

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(409)

&lt;223&gt; RXA01052

&lt;400&gt; 193

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acgaacaacg	aagagcttgc	ccgagagtat	cttgggtcgc	atg	gac	aca	aaa	tta	115
				Met	Asp	Thr	Lys	Leu	
				1				5	

ggc	gct	gaa	ttg	ggt	act	gaa	ttt	gat	ctc	att	ggt	ggt	ggt	ttc	ggc	163
Gly	Ala	Glu	Leu	Gly	Thr	Glu	Phe	Asp	Leu	Ile	Val	Val	Gly	Phe	Gly	
			10					15						20		

aaa gca ggc aag act atc gcg atg aaa cgc tcg gca gcg ggg gat aag 211  
 Lys Ala Gly Lys Thr Ile Ala Met Lys Arg Ser Ala Ala Gly Asp Lys  
           25                          30                          35

gtc gca ctg atc gag cag agt cca cag atg tat ggc ggt acc tgc atc 259  
 Val Ala Leu Ile Glu Gln Ser Pro Gln Met Tyr Gly Gly Thr Cys Ile  
           40                          45                          50

aat gta ggt tgc atc ccc acg aag aag ttg ttg ttt gag act gca acg 307  
 Asn Val Gly Cys Ile Pro Thr Lys Lys Leu Leu Phe Glu Thr Ala Thr  
           55                          60                          65

ggc aag gat ttc ccg gat gcg gtt gtg gcg cgt gat cag ttg att ggc 355  
 Gly Lys Asp Phe Pro Asp Ala Val Val Ala Arg Asp Gln Leu Ile Gly  
           70                          75                          80                          85

aag ctg aat gcc aag aat ctt gcg atg gcc aca gac aag ggt gtc acc 403  
 Lys Leu Asn Ala Lys Asn Leu Ala Met Ala Thr Asp Lys Gly Val Thr  
                           90                          95                          100

cgt cat tgatggaaaa gctacgttta cag 432  
 Arg His

<210> 194  
 <211> 103  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 194  
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Val Val Gly Phe Gly Lys Ala Gly Lys Thr Ile Ala Met Lys Arg Ser  
           20                          25                          30

Ala Ala Gly Asp Lys Val Ala Leu Ile Glu Gln Ser Pro Gln Met Tyr  
           35                          40                          45

Gly Gly Thr Cys Ile Asn Val Gly Cys Ile Pro Thr Lys Lys Leu Leu  
           50                          55                          60

Phe Glu Thr Ala Thr Gly Lys Asp Phe Pro Asp Ala Val Val Ala Arg  
   65                          70                          75                          80

Asp Gln Leu Ile Gly Lys Leu Asn Ala Lys Asn Leu Ala Met Ala Thr  
                           85                          90                          95

Asp Lys Gly Val Thr Arg His  
           100

<210> 195  
 <211> 543  
 <212> DNA  
 <213> Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(520)

&lt;223&gt; RXA01053

&lt;400&gt; 195

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agccacgaaa tcacaagtaa cttcaggtag tgacactctt gtg ctg tat gcg cca 115  
 Val Leu Tyr Ala Pro  
 1 5

acg att gtg atc aac acg ggc tcc acg ccg gtc atc ccc aat gtc cca 163  
 Thr Ile Val Ile Asn Thr Gly Ser Thr Pro Val Ile Pro Asn Val Pro  
 10 15 20

ggc acc gac aat ccg cat gtt ttt gat tcc act ggc att cag cac att 211  
 Gly Thr Asp Asn Pro His Val Phe Asp Ser Thr Gly Ile Gln His Ile  
 25 30 35

tcg ccc ctg ccg aag cac ctc gcg atc atc ggc ggt ggc ccc atc ggt 259  
 Ser Pro Leu Pro Lys His Leu Ala Ile Ile Gly Gly Gly Pro Ile Gly  
 40 45 50

ttg gaa ttt gcc acg ctt ttc agt gga caa ggc tcc aaa gtc acc atc 307  
 Leu Glu Phe Ala Thr Leu Phe Ser Gly Gln Gly Ser Lys Val Thr Ile  
 55 60 65

atc gac cgt ggt gaa ttg ccg ctg aaa aat ttc gac agg gaa gta gcg 355  
 Ile Asp Arg Gly Glu Leu Pro Leu Lys Asn Phe Asp Arg Glu Val Ala  
 70 75 80 85

gag ctg gcc aaa acc gac ctg gag gcc cgc gga atc acc ttc ctc aac 403  
 Glu Leu Ala Lys Thr Asp Leu Glu Ala Arg Gly Ile Thr Phe Leu Asn  
 90 95 100

aac gct gaa ctc acc gga ttc agc ggt gac ctc acc atc gcg ctc aaa 451  
 Asn Ala Glu Leu Thr Gly Phe Ser Gly Asp Leu Thr Ile Ala Leu Lys  
 105 110 115

gac cac gac ctc ctc gcc gac gcc gca ctt ttt gca tcg gcc gac gcc 499  
 Asp His Asp Leu Leu Ala Asp Ala Ala Leu Phe Ala Ser Ala Asp Ala  
 120 125 130

cgg cac cga cgg gct cgg cct tgaacaggcg ggcacaaaa cag 543  
 Arg His Arg Arg Ala Arg Pro  
 135 140

&lt;210&gt; 196

&lt;211&gt; 140

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 196

Val Leu Tyr Ala Pro Thr Ile Val Ile Asn Thr Gly Ser Thr Pro Val

1	5	10	15
Ile Pro Asn Val	Pro Gly Thr Asp	Asn Pro His Val	Phe Asp Ser Thr
20	25	30	
Gly Ile Gln His	Ile Ser Pro Leu	Pro Lys His Leu	Ala Ile Ile Gly
35	40	45	
Gly Gly Pro Ile	Gly Leu Glu Phe	Ala Thr Leu Phe	Ser Gly Gln Gly
50	55	60	
Ser Lys Val Thr	Ile Ile Asp Arg	Gly Glu Leu Pro	Leu Lys Asn Phe
65	70	75	80
Asp Arg Glu Val	Ala Glu Leu Ala	Lys Thr Asp Leu	Glu Ala Arg Gly
85	90	95	
Ile Thr Phe Leu	Asn Asn Ala Glu	Leu Thr Gly Phe	Ser Gly Asp Leu
100	105	110	
Thr Ile Ala Leu	Lys Asp His Asp	Leu Leu Ala Asp	Ala Ala Leu Phe
115	120	125	
Ala Ser Ala Asp	Ala Arg His Arg	Arg Ala Arg Pro	
130	135	140	

<210> 197  
 <211> 612  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(589)  
 <223> RXA01054

<400> 197  
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 ccttgaacag gcgggcatca aaacaggcac gcgtggggag gtg ctt gtc gac gcc 115  
 Val Leu Val Asp Ala  
 1 5  
 cac ctc cgg acc aac atc gac ggc atc ttc gct gta ggt gat gtc aat 163  
 His Leu Arg Thr Asn Ile Asp Gly Ile Phe Ala Val Gly Asp Val Asn  
 10 15 20  
 ggc ggc ccg cag ttt acc tac gtg tcc tac gat gac cac cgc att gtg 211  
 Gly Gly Pro Gln Phe Thr Tyr Val Ser Tyr Asp Asp His Arg Ile Val  
 25 30 35  
 ctg gat caa cta gcc gga aca ggt aag aaa tcc att gca cac cga ctg 259  
 Leu Asp Gln Leu Ala Gly Thr Gly Lys Lys Ser Ile Ala His Arg Leu  
 40 45 50  
 atc ccc acc acc acg ttc atc gaa ccg ccg tta tcc acc atc ggt gac 307



Ile Pro Thr Thr Thr Phe Ile Glu Pro Pro Leu Ser Thr Ile Gly Asp  
55 60 65

aac act gaa ggg gaa aat gtg gtg gtg aaa aag gcc ttg att gca gat 355  
Asn Thr Glu Gly Glu Asn Val Val Val Lys Lys Ala Leu Ile Ala Asp  
70 75 80 85

atg ccg atc gtt ccc cga cca gag att att aac caa cct cac ggt atg 403  
Met Pro Ile Val Pro Arg Pro Glu Ile Ile Asn Gln Pro His Gly Met  
90 95 100

gtg aag ttt ttc gtc gac aag caa tct gat gcg ctg ctc ggc gcg acc 451  
Val Lys Phe Phe Val Asp Lys Gln Ser Asp Ala Leu Leu Gly Ala Thr  
105 110 115

ttg tac tgc gcc gac tcc cag gag ctc atc aac acc gtg gcg ctt gcc 499  
Leu Tyr Cys Ala Asp Ser Gln Glu Leu Ile Asn Thr Val Ala Leu Ala  
120 125 130

atg cgg cat ggc gtc acc gcc tcc gag ctt ggc gac ggc atc tac acc 547  
Met Arg His Gly Val Thr Ala Ser Glu Leu Gly Asp Gly Ile Tyr Thr  
135 140 145

cac ccc gcc acc tcg gag atc ttc aac caa tta ttg ggc agt 589  
His Pro Ala Thr Ser Glu Ile Phe Asn Gln Leu Leu Gly Ser  
150 155 160

taacgcagcg gatcgaacgg ctt 612

<210> 198  
<211> 163  
<212> PRT  
<213> Corynebacterium glutamicum

<400> 198  
Val Leu Val Asp Ala His Leu Arg Thr Asn Ile Asp Gly Ile Phe Ala  
1 5 10 15

Val Gly Asp Val Asn Gly Gly Pro Gln Phe Thr Tyr Val Ser Tyr Asp  
20 25 30

Asp His Arg Ile Val Leu Asp Gln Leu Ala Gly Thr Gly Lys Lys Ser  
35 40 45

Ile Ala His Arg Leu Ile Pro Thr Thr Thr Phe Ile Glu Pro Pro Leu  
50 55 60

Ser Thr Ile Gly Asp Asn Thr Glu Gly Glu Asn Val Val Val Lys Lys  
65 70 75 80

Ala Leu Ile Ala Asp Met Pro Ile Val Pro Arg Pro Glu Ile Ile Asn  
85 90 95

Gln Pro His Gly Met Val Lys Phe Phe Val Asp Lys Gln Ser Asp Ala  
100 105 110

Leu Leu Gly Ala Thr Leu Tyr Cys Ala Asp Ser Gln Glu Leu Ile Asn  
115 120 125

Thr Val Ala Leu Ala Met Arg His Gly Val Thr Ala Ser Glu Leu Gly  
130 135 140

Asp Gly Ile Tyr Thr His Pro Ala Thr Ser Glu Ile Phe Asn Gln Leu  
145 150 155 160

Leu Gly Ser

<210> 199

<211> 561

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(538)

<223> RXN03123

<400> 199

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tggtttttgt gctgcacgag ccgctggggc ccgcctcggc gtg ggc gac gcg ctg 115  
Val Gly Asp Ala Leu  
1 5

cga ggc cgg gga aag cct gaa gtc atg cgc tac cca gga att ccg ttc 163  
Arg Gly Arg Gly Lys Pro Glu Val Met Arg Tyr Pro Gly Ile Pro Phe  
10 15 20

gcc atc cca gat cca gcg ccg cgt ggc ttc ctt ttc tta ggc gat ctc 211  
Ala Ile Pro Asp Pro Ala Pro Arg Gly Phe Leu Phe Leu Gly Asp Leu  
25 30 35

acc tct tac cca gcg atc tgc tcg att ctg gag acc ttg gac ggt gaa 259  
Thr Ser Tyr Pro Ala Ile Cys Ser Ile Leu Glu Thr Leu Asp Gly Glu  
40 45 50

atc cct gcg acc gcg tat ctt atc gcc cac gat cca ctt gat tac acc 307  
Ile Pro Ala Thr Ala Tyr Leu Ile Ala His Asp Pro Leu Asp Tyr Thr  
55 60 65

ttc gat ttt ccc cag ggc gag cac atc acc gcg cag tgg att tcc aac 355  
Phe Asp Phe Pro Gln Gly Glu His Ile Thr Ala Gln Trp Ile Ser Asn  
70 75 80 85

gaa caa tcc ttc att gat cac atc gct gac acg gat tac acc gat ttt 403  
Glu Gln Ser Phe Ile Asp His Ile Ala Asp Thr Asp Tyr Thr Asp Phe  
90 95 100

tat acc tgg atc ggc gcg gaa tcc tcc gaa acc cgt gcg gcc aag aag 451  
Tyr Thr Trp Ile Gly Ala Glu Ser Ser Glu Thr Arg Ala Ala Lys Lys  
105 110 115

cat ctg cag acc cac gcc ggc atg ccc aag acg cac atg aac gcg caa 499  
 His Leu Gln Thr His Ala Gly Met Pro Lys Thr His Met Asn Ala Gln  
           120                          125                          130

ggc tat tgg aac aag ggc aga gcc atg ggt aaa agc aat taaaagattt 548  
 Gly Tyr Trp Asn Lys Gly Arg Ala Met Gly Lys Ser Asn  
           135                          140                          145

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<210> 200  
 <211> 146  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 200  
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       1                          5                          10                          15

Pro Gly Ile Pro Phe Ala Ile Pro Asp Pro Ala Pro Arg Gly Phe Leu  
           20                          25                          30

Phe Leu Gly Asp Leu Thr Ser Tyr Pro Ala Ile Cys Ser Ile Leu Glu  
           35                          40                          45

Thr Leu Asp Gly Glu Ile Pro Ala Thr Ala Tyr Leu Ile Ala His Asp  
           50                          55                          60

Pro Leu Asp Tyr Thr Phe Asp Phe Pro Gln Gly Glu His Ile Thr Ala  
       65                          70                          75                          80

Gln Trp Ile Ser Asn Glu Gln Ser Phe Ile Asp His Ile Ala Asp Thr  
           85                          90                          95

Asp Tyr Thr Asp Phe Tyr Thr Trp Ile Gly Ala Glu Ser Ser Glu Thr  
           100                          105                          110

Arg Ala Ala Lys Lys His Leu Gln Thr His Ala Gly Met Pro Lys Thr  
           115                          120                          125

His Met Asn Ala Gln Gly Tyr Trp Asn Lys Gly Arg Ala Met Gly Lys  
           130                          135                          140

Ser Asn  
 145

<210> 201  
 <211> 736  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(736)

&lt;223&gt; FRXA00993

&lt;400&gt; 201

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atttacaggg tgttgtgaaa gcataaggga gcaaggaaac atg ggc aag gga ttt 115  
 Met Gly Lys Gly Phe  
 1 5

acc ggc gct att ttg acc gtc atg ggc gtg aaa tcg cat atc gcc acc 163  
 Thr Gly Ala Ile Leu Thr Val Met Gly Val Lys Ser His Ile Ala Thr  
 10 15 20

acc acg gga aaa acc gtg atc aat gac cgc atg gtg acc att cat ttt 211  
 Thr Thr Gly Lys Thr Val Ile Asn Asp Arg Met Val Thr Ile His Phe  
 25 30 35

cat tcc gag acg ctg ctc aac acg gaa ggt gaa gtc ccc ggc gat tgg 259  
 His Ser Glu Thr Leu Leu Asn Thr Glu Gly Glu Val Pro Gly Asp Trp  
 40 45 50

ctg cgt ctg tgg ttc ccg cac gag agc cga cct gga aag ctc tac caa 307  
 Leu Arg Leu Trp Phe Pro His Glu Ser Arg Pro Gly Lys Leu Tyr Gln  
 55 60 65

cgc gcc tac acc ttg acc aac gtg gat gcc gat gcc ggt acc ttt gac 355  
 Arg Ala Tyr Thr Leu Thr Asn Val Asp Ala Asp Ala Gly Thr Phe Asp  
 70 75 80 85

ctg gct ttt gtg ctg cac gag ccg ctg ggg ccc gcc tcg gcg tgg gcg 403  
 Leu Ala Phe Val Leu His Glu Pro Leu Gly Pro Ala Ser Ala Trp Ala  
 90 95 100

acg cgc tgc gag gcc ggg gaa agc ctg gaa gtc atg cgc tac cca gga 451  
 Thr Arg Cys Glu Ala Gly Glu Ser Leu Glu Val Met Arg Tyr Pro Gly  
 105 110 115

att ccg ttc gcc atc cca gat cca gcg ccg cgt ggc ttc ctt ttc cta 499  
 Ile Pro Phe Ala Ile Pro Asp Pro Ala Pro Arg Gly Phe Leu Phe Leu  
 120 125 130

ggc gat ctc acc tct tac cca gcg atc tgc tcg att ctg gag acc ttg 547  
 Gly Asp Leu Thr Ser Tyr Pro Ala Ile Cys Ser Ile Leu Glu Thr Leu  
 135 140 145

gac ggt gaa atc cct gcg acc gcg tat ctt atc gcc cac gat cca ctt 595  
 Asp Gly Glu Ile Pro Ala Thr Ala Tyr Leu Ile Ala His Asp Pro Leu  
 150 155 160 165

gat tac acc ttc gat ttt ccc cag ggc gag cac atc acc gcg cag tgg 643  
 Asp Tyr Thr Phe Asp Phe Pro Gln Gly Glu His Ile Thr Ala Gln Trp  
 170 175 180

att tcc aac gaa caa tcc ttc att gat cac atc gct gac acg gat tac 691  
 Ile Ser Asn Glu Gln Ser Phe Ile Asp His Ile Ala Asp Thr Asp Tyr  
 185 190 195

acc gat ttt tat acc tgg atc ggc gcg gaa tcc tcc gaa acc cgt  
 Thr Asp Phe Tyr Thr Trp Ile Gly Ala Glu Ser Ser Glu Thr Arg  
 200 205 210

736

&lt;210&gt; 202

&lt;211&gt; 212

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 202

Met Gly Lys Gly Phe Thr Gly Ala Ile Leu Thr Val Met Gly Val Lys  
 1 5 10 15

Ser His Ile Ala Thr Thr Thr Gly Lys Thr Val Ile Asn Asp Arg Met  
 20 25 30

Val Thr Ile His Phe His Ser Glu Thr Leu Leu Asn Thr Glu Gly Glu  
 35 40 45

Val Pro Gly Asp Trp Leu Arg Leu Trp Phe Pro His Glu Ser Arg Pro  
 50 55 60

Gly Lys Leu Tyr Gln Arg Ala Tyr Thr Leu Thr Asn Val Asp Ala Asp  
 65 70 75 80

Ala Gly Thr Phe Asp Leu Ala Phe Val Leu His Glu Pro Leu Gly Pro  
 85 90 95

Ala Ser Ala Trp Ala Thr Arg Cys Glu Ala Gly Glu Ser Leu Glu Val  
 100 105 110

Met Arg Tyr Pro Gly Ile Pro Phe Ala Ile Pro Asp Pro Ala Pro Arg  
 115 120 125

Gly Phe Leu Phe Leu Gly Asp Leu Thr Ser Tyr Pro Ala Ile Cys Ser  
 130 135 140

Ile Leu Glu Thr Leu Asp Gly Glu Ile Pro Ala Thr Ala Tyr Leu Ile  
 145 150 155 160

Ala His Asp Pro Leu Asp Tyr Thr Phe Asp Phe Pro Gln Gly Glu His  
 165 170 175

Ile Thr Ala Gln Trp Ile Ser Asn Glu Gln Ser Phe Ile Asp His Ile  
 180 185 190

Ala Asp Thr Asp Tyr Thr Asp Phe Tyr Thr Trp Ile Gly Ala Glu Ser  
 195 200 205

Ser Glu Thr Arg  
 210

&lt;210&gt; 203

&lt;211&gt; 732

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(709)

&lt;223&gt; RXA01051

&lt;400&gt; 203

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taacagtgaa cacacaggcc atccccctag ggttggccat atg tca acc att cac 115
                                     Met Ser Thr Ile His
                                     1                               5

gcc tcc gga atc cag gct cca caa gtg cca cac ggt tcc cac cat gcc 163
Ala Ser Gly Ile Gln Ala Pro Gln Val Pro His Gly Ser His His Ala
                        10                        15                        20

ccg cca caa aag gac gaa tca gtg aag aag agc ttc aat gcc tct tct 211
Pro Pro Gln Lys Asp Glu Ser Val Lys Lys Ser Phe Asn Ala Ser Ser
                        25                        30                        35

tta ctg ttc gcg ttt tcc ttc ggc gtg tac ctg gtg ctg ctt gtg atg 259
Leu Leu Phe Ala Phe Ser Phe Gly Val Tyr Leu Val Leu Leu Val Met
                        40                        45                        50

atg aca ctt ctt aaa agt cgc ctt tct tta ggc gga ctg tgg aac aca 307
Met Thr Leu Leu Lys Ser Arg Leu Ser Leu Gly Gly Leu Trp Asn Thr
                        55                        60                        65

gaa gca cac caa tac aga tcc atc gac tta gag ctt ttc aac ggc ttt 355
Glu Ala His Gln Tyr Arg Ser Ile Asp Leu Glu Leu Phe Asn Gly Phe
70                        75                        80                        85

gct gat cca cca att tgg tgg ggg cct tgg acc aac act ttt ggc aac 403
Ala Asp Pro Pro Ile Trp Trp Gly Pro Trp Thr Asn Thr Phe Gly Asn
                        90                        95                        100

atc gca ctg ttc atg cca ttt ggg ttt ttc ctg tac aaa atg ctc cgt 451
Ile Ala Leu Phe Met Pro Phe Gly Phe Phe Leu Tyr Lys Met Leu Arg
                        105                        110                        115

aga ttc aac cat cga ttc ccc ttc gta gaa acc atc ctg ttt gcc agc 499
Arg Phe Asn His Arg Phe Pro Phe Val Glu Thr Ile Leu Phe Ala Ser
                        120                        125                        130

gtc acc agc ctc agt atc gaa gtt ctg caa tgg gtg ttt gct att gga 547
Val Thr Ser Leu Ser Ile Glu Val Leu Gln Trp Val Phe Ala Ile Gly
                        135                        140                        145

tat tca gat gtc gat gac ctg ttg ttt aat acg atc ggc gga ctc att 595
Tyr Ser Asp Val Asp Asp Leu Leu Phe Asn Thr Ile Gly Gly Leu Ile
150                        155                        160                        165

gga gca tcc gta gca gcg ctt gtc tcg ctt aaa tcc tcc aag gta gtc 643
Gly Ala Ser Val Ala Ala Leu Val Ser Leu Lys Ser Ser Lys Val Val
                        170                        175                        180

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agc gga atc atc atg ggc ggt tca cta tct gtg atg gcg atg atg atg 691  
 Ser Gly Ile Ile Met Gly Gly Ser Leu Ser Val Met Ala Met Met Met  
                   185                                  190                                  195

tat tca agt ttt atc gcc tagaagggtt cagcagttcc gct 732  
 Tyr Ser Ser Phe Ile Ala  
                   200

<210> 204

<211> 203

<212> PRT

<213> Corynebacterium glutamicum

<400> 204

Met Ser Thr Ile His Ala Ser Gly Ile Gln Ala Pro Gln Val Pro His  
       1                                  5                                  10                                  15

Gly Ser His His Ala Pro Pro Gln Lys Asp Glu Ser Val Lys Lys Ser  
                   20                                  25                                  30

Phe Asn Ala Ser Ser Leu Leu Phe Ala Phe Ser Phe Gly Val Tyr Leu  
                   35                                  40                                  45

Val Leu Leu Val Met Met Thr Leu Leu Lys Ser Arg Leu Ser Leu Gly  
                   50                                  55                                  60

Gly Leu Trp Asn Thr Glu Ala His Gln Tyr Arg Ser Ile Asp Leu Glu  
       65                                  70                                  75                                  80

Leu Phe Asn Gly Phe Ala Asp Pro Pro Ile Trp Trp Gly Pro Trp Thr  
                   85                                  90                                  95

Asn Thr Phe Gly Asn Ile Ala Leu Phe Met Pro Phe Gly Phe Phe Leu  
                   100                                  105                                  110

Tyr Lys Met Leu Arg Arg Phe Asn His Arg Phe Pro Phe Val Glu Thr  
                   115                                  120                                  125

Ile Leu Phe Ala Ser Val Thr Ser Leu Ser Ile Glu Val Leu Gln Trp  
                   130                                  135                                  140

Val Phe Ala Ile Gly Tyr Ser Asp Val Asp Asp Leu Leu Phe Asn Thr  
       145                                  150                                  155                                  160

Ile Gly Gly Leu Ile Gly Ala Ser Val Ala Ala Leu Val Ser Leu Lys  
                   165                                  170                                  175

Ser Ser Lys Val Val Ser Gly Ile Ile Met Gly Gly Ser Leu Ser Val  
                   180                                  185                                  190

Met Ala Met Met Met Tyr Ser Ser Phe Ile Ala  
                   195                                  200

<210> 205



&lt;211&gt; 1359

&lt;212&gt; DNA

<213> *Corynebacterium glutamicum*

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(1336)

&lt;223&gt; RXN01873

&lt;400&gt; 205

ccgtcgttgc ccatgggtcac agcctacatg cacaaagtga atcaaaaaca gctattttcta 60

acattttact aatatttgct gttggcgcac gatgaactcc atg agc caa gca ata 115  
 Met Ser Gln Ala Ile  
 1 5

gat agc aag gtc gag gca cac gaa ggc cac gaa ggc cac gaa ggc atc 163  
 Asp Ser Lys Val Glu Ala His Glu Gly His Glu Gly His Glu Gly Ile  
 10 15 20

gag cga gga aca cgc aat tac aag cgc gct gtg ttt gcg atg ctg gcc 211  
 Glu Arg Gly Thr Arg Asn Tyr Lys Arg Ala Val Phe Ala Met Leu Ala  
 25 30 35

gcc ggt ctt gct gct ttc aat ggt ctt tat tgc acg cag gca ttg ctt 259  
 Ala Gly Leu Ala Ala Phe Asn Gly Leu Tyr Cys Thr Gln Ala Leu Leu  
 40 45 50

ccc acc atg acg gaa gag ttg gga att acg ccc act gag tcc gcg ctg 307  
 Pro Thr Met Thr Glu Glu Leu Gly Ile Thr Pro Thr Glu Ser Ala Leu  
 55 60 65

acg gtg tcg gct acg act gga atg ttg gcg ctg tgt att gtt ccg gcg 355  
 Thr Val Ser Ala Thr Thr Gly Met Leu Ala Leu Cys Ile Val Pro Ala  
 70 75 80 85

tcg ata ctt tcg gag aaa ttt ggt cgc ggt cgg gtg ctg aca att tca 403  
 Ser Ile Leu Ser Glu Lys Phe Gly Arg Gly Arg Val Leu Thr Ile Ser  
 90 95 100

ctc acg ttg gcc atc atc gtg gga tta att ttg ccg ctt gtc ccc aat 451  
 Leu Thr Leu Ala Ile Ile Val Gly Leu Ile Leu Pro Leu Val Pro Asn  
 105 110 115

att act gct ctc atc ctg ctc aga ggt ctc caa ggt gcg ctg ctt gct 499  
 Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln Gly Ala Leu Leu Ala  
 120 125 130

ggc act cca gcg gtg gcg atg acc tgg ttg tct gag gaa att cac ccc 547  
 Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser Glu Glu Ile His Pro  
 135 140 145

aag gat att ggg cat gcg atg gga att tac atc gcg gga aat act gtc 595  
 Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile Ala Gly Asn Thr Val  
 150 155 160 165

ggc ggg ctc act gga cgt atg att ccg gcg gga cta ctt gaa gta act 643

Gly	Gly	Leu	Thr	Gly	Arg	Met	Ile	Pro	Ala	Gly	Leu	Leu	Glu	Val	Thr		
				170					175					180			
cat	tgg	caa	aac	gca	ctg	ctg	gga	agt	tct	atc	gct	gcg	ctg	atc	ttc	691	
His	Trp	Gln	Asn	Ala	Leu	Leu	Gly	Ser	Ser	Ile	Ala	Ala	Leu	Ile	Phe		
			185					190					195				
ggc	gta	atc	atg	gtg	gtg	ttg	ctt	ccc	aag	cag	cgg	aaa	ttc	cag	ccg	739	
Gly	Val	Ile	Met	Val	Val	Leu	Leu	Pro	Lys	Gln	Arg	Lys	Phe	Gln	Pro		
		200					205					210					
aag	aat	atc	aat	ctg	cgc	cat	gag	att	tcg	gcg	atg	gct	gct	cat	tgg	787	
Lys	Asn	Ile	Asn	Leu	Arg	His	Glu	Ile	Ser	Ala	Met	Ala	Ala	His	Trp		
	215					220					225						
cgg	aat	cct	cgt	ttg	gcg	ttg	ctt	ttt	ggc	act	gcg	ttt	ttg	ggc	atg	835	
Arg	Asn	Pro	Arg	Leu	Ala	Leu	Leu	Phe	Gly	Thr	Ala	Phe	Leu	Gly	Met		
230					235					240					245		
ggc	act	ttt	gtg	tcg	ctg	tac	aac	tat	ttg	ggc	ttc	cgc	atg	att	gat	883	
Gly	Thr	Phe	Val	Ser	Leu	Tyr	Asn	Tyr	Leu	Gly	Phe	Arg	Met	Ile	Asp		
			250						255					260			
cag	ttt	ggg	ctg	agt	gaa	gtg	ctg	gtt	ggc	gcg	gtg	ttc	atc	atg	tat	931	
Gln	Phe	Gly	Leu	Ser	Glu	Val	Leu	Val	Gly	Ala	Val	Phe	Ile	Met	Tyr		
			265					270					275				
ctg	gcc	ggg	acc	tgg	agt	tcc	acc	cag	gcg	ggc	gcg	ttg	agg	gag	aag	979	
Leu	Ala	Gly	Thr	Trp	Ser	Ser	Thr	Gln	Ala	Gly	Ala	Leu	Arg	Glu	Lys		
		280					285					290					
atc	ggc	aat	ggg	tca	acg	gtt	att	ttc	ttg	agt	ctg	acg	atg	atc	gcg	1027	
Ile	Gly	Asn	Gly	Ser	Thr	Val	Ile	Phe	Leu	Ser	Leu	Thr	Met	Ile	Ala		
	295					300					305						
tcg	atg	gca	ctg	atg	ggg	att	aat	aat	ttg	tgg	gtc	acg	ttg	gtt	gcc	1075	
Ser	Met	Ala	Leu	Met	Gly	Ile	Asn	Asn	Leu	Trp	Val	Thr	Leu	Val	Ala		
310					315					320					325		
ctg	ttt	gtg	ttt	acc	gcg	gca	ttt	ttc	gca	ctg	cat	tcc	agt	gct	tcg	1123	
Leu	Phe	Val	Phe	Thr	Ala	Ala	Phe	Phe	Ala	Leu	His	Ser	Ser	Ala	Ser		
				330					335					340			
gga	tgg	atc	gga	atc	atc	gca	acg	aag	gat	cgc	gcg	gaa	gcc	tcc	agc	1171	
Gly	Trp	Ile	Gly	Ile	Ile	Ala	Thr	Lys	Asp	Arg	Ala	Glu	Ala	Ser	Ser		
			345					350					355				
atg	tat	ttg	ttc	tgt	tat	tac	gtg	gga	tcc	tcg	gtg	att	ggc	tgg	gtt	1219	
Met	Tyr	Leu	Phe	Cys	Tyr	Tyr	Val	Gly	Ser	Ser	Val	Ile	Gly	Trp	Val		
		360					365					370					
tct	gga	ttc	gcg	ttt	acg	cat	ttg	ccg	tgg	ttg	gcg	ttc	att	ggc	tgg	1267	
Ser	Gly	Phe	Ala	Phe	Thr	His	Leu	Pro	Trp	Leu	Ala	Phe	Ile	Gly	Trp		
	375					380					385						
ttg	att	ctg	ctt	ctt	tgc	gga	gtg	ctg	gcg	att	tgt	gtg	acg	ctg	gca	1315	
Leu	Ile	Leu	Leu	Leu	Cys	Gly	Val	Leu	Ala	Ile	Cys	Val	Thr	Leu	Ala		

390

395

400

405

agg ctt gcc cgc aac gcc aat taatacgagt ttgtccgtgt tta  
 Arg Leu Ala Arg Asn Ala Asn  
 410

1359

&lt;210&gt; 206

&lt;211&gt; 412

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 206

Met Ser Gln Ala Ile Asp Ser Lys Val Glu Ala His Glu Gly His Glu  
 1 5 10 15

Gly His Glu Gly Ile Glu Arg Gly Thr Arg Asn Tyr Lys Arg Ala Val  
 20 25 30

Phe Ala Met Leu Ala Ala Gly Leu Ala Ala Phe Asn Gly Leu Tyr Cys  
 35 40 45

Thr Gln Ala Leu Leu Pro Thr Met Thr Glu Glu Leu Gly Ile Thr Pro  
 50 55 60

Thr Glu Ser Ala Leu Thr Val Ser Ala Thr Thr Gly Met Leu Ala Leu  
 65 70 75 80

Cys Ile Val Pro Ala Ser Ile Leu Ser Glu Lys Phe Gly Arg Gly Arg  
 85 90 95

Val Leu Thr Ile Ser Leu Thr Leu Ala Ile Ile Val Gly Leu Ile Leu  
 100 105 110

Pro Leu Val Pro Asn Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln  
 115 120 125

Gly Ala Leu Leu Ala Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser  
 130 135 140

Glu Glu Ile His Pro Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile  
 145 150 155 160

Ala Gly Asn Thr Val Gly Gly Leu Thr Gly Arg Met Ile Pro Ala Gly  
 165 170 175

Leu Leu Glu Val Thr His Trp Gln Asn Ala Leu Leu Gly Ser Ser Ile  
 180 185 190

Ala Ala Leu Ile Phe Gly Val Ile Met Val Val Leu Leu Pro Lys Gln  
 195 200 205

Arg Lys Phe Gln Pro Lys Asn Ile Asn Leu Arg His Glu Ile Ser Ala  
 210 215 220

Met Ala Ala His Trp Arg Asn Pro Arg Leu Ala Leu Leu Phe Gly Thr  
 225 230 235 240

Ala Phe Leu Gly Met Gly Thr Phe Val Ser Leu Tyr Asn Tyr Leu Gly  
 245 250 255

Phe Arg Met Ile Asp Gln Phe Gly Leu Ser Glu Val Leu Val Gly Ala  
 260 265 270

Val Phe Ile Met Tyr Leu Ala Gly Thr Trp Ser Ser Thr Gln Ala Gly  
 275 280 285

Ala Leu Arg Glu Lys Ile Gly Asn Gly Ser Thr Val Ile Phe Leu Ser  
 290 295 300

Leu Thr Met Ile Ala Ser Met Ala Leu Met Gly Ile Asn Asn Leu Trp  
 305 310 315 320

Val Thr Leu Val Ala Leu Phe Val Phe Thr Ala Ala Phe Phe Ala Leu  
 325 330 335

His Ser Ser Ala Ser Gly Trp Ile Gly Ile Ile Ala Thr Lys Asp Arg  
 340 345 350

Ala Glu Ala Ser Ser Met Tyr Leu Phe Cys Tyr Tyr Val Gly Ser Ser  
 355 360 365

Val Ile Gly Trp Val Ser Gly Phe Ala Phe Thr His Leu Pro Trp Leu  
 370 375 380

Ala Phe Ile Gly Trp Leu Ile Leu Leu Leu Cys Gly Val Leu Ala Ile  
 385 390 395 400

Cys Val Thr Leu Ala Arg Leu Ala Arg Asn Ala Asn  
 405 410

<210> 207  
 <211> 1215  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (101)..(1192)  
 <223> FRXA01873

<400> 207  
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 acatttttact aatattttgct gttggcgcat gatgaactcc atg agc caa gca ata 115  
 Met Ser Gln Ala Ile  
 1 5  
 gat agc aag gtc gag gca cac gaa ggc cac gaa ggc cac gaa ggc atc 163  
 Asp Ser Lys Val Glu Ala His Glu Gly His Glu Gly His Glu Gly Ile  
 10 15 20  
 gag cga gga aca cgc aat tac aag cgc gct gtg ttt gcg atg ctg gcc 211

Glu	Arg	Gly	Thr	Arg	Asn	Tyr	Lys	Arg	Ala	Val	Phe	Ala	Met	Leu	Ala		
			25					30					35				
gcc	ggt	ctt	gct	gct	ttc	aat	ggt	ctt	tat	tgc	acg	cag	gca	ttg	ctt	259	
Ala	Gly	Leu	Ala	Ala	Phe	Asn	Gly	Leu	Tyr	Cys	Thr	Gln	Ala	Leu	Leu		
		40					45					50					
ccc	acc	atg	acg	gaa	gag	ttg	gga	att	acg	ccc	act	gag	tcc	gcg	ctg	307	
Pro	Thr	Met	Thr	Glu	Glu	Leu	Gly	Ile	Thr	Pro	Thr	Glu	Ser	Ala	Leu		
	55					60					65						
acg	gtg	tcg	gct	acg	act	gga	atg	ttg	gcg	ctg	tgt	att	gtt	ccg	gcg	355	
Thr	Val	Ser	Ala	Thr	Thr	Gly	Met	Leu	Ala	Leu	Cys	Ile	Val	Pro	Ala		
70					75				80						85		
tcg	ata	ctt	tcg	gag	aaa	ttt	ggt	cgc	ggt	cgg	gtg	ctg	aca	att	tca	403	
Ser	Ile	Leu	Ser	Glu	Lys	Phe	Gly	Arg	Gly	Arg	Val	Leu	Thr	Ile	Ser		
				90				95						100			
ctc	acg	ttg	gcc	atc	atc	gtg	gga	tta	att	ttg	ccg	ctt	gtc	ccc	aat	451	
Leu	Thr	Leu	Ala	Ile	Ile	Val	Gly	Leu	Ile	Leu	Pro	Leu	Val	Pro	Asn		
			105				110						115				
att	act	gct	ctc	atc	ctg	ctc	aga	ggt	ctc	caa	ggt	gcg	ctg	ctt	gct	499	
Ile	Thr	Ala	Leu	Ile	Leu	Leu	Arg	Gly	Leu	Gln	Gly	Ala	Leu	Leu	Ala		
		120					125					130					
ggc	act	cca	gcg	gtg	gcg	atg	acc	tgg	ttg	tct	gag	gaa	att	cac	ccc	547	
Gly	Thr	Pro	Ala	Val	Ala	Met	Thr	Trp	Leu	Ser	Glu	Glu	Ile	His	Pro		
	135					140					145						
aag	gat	att	ggg	cat	gcg	atg	gga	att	tac	atc	gcg	gga	aat	act	gtc	595	
Lys	Asp	Ile	Gly	His	Ala	Met	Gly	Ile	Tyr	Ile	Ala	Gly	Asn	Thr	Val		
150				155					160						165		
ggc	ggg	ctc	act	gga	cgt	atg	att	ccg	gcg	gga	cta	ctt	gaa	gta	act	643	
Gly	Gly	Leu	Thr	Gly	Arg	Met	Ile	Pro	Ala	Gly	Leu	Leu	Glu	Val	Thr		
				170				175					180				
cat	tgg	caa	aac	gca	ctg	ctg	gga	agt	tct	atc	gct	gcg	ctg	atc	ttc	691	
His	Trp	Gln	Asn	Ala	Leu	Leu	Gly	Ser	Ser	Ile	Ala	Ala	Leu	Ile	Phe		
			185				190						195				
ggc	gta	atc	atg	gtg	gtg	ttg	ctt	ccc	aag	cag	cgg	aaa	ttc	cag	ccg	739	
Gly	Val	Ile	Met	Val	Val	Leu	Leu	Pro	Lys	Gln	Arg	Lys	Phe	Gln	Pro		
		200				205						210					
aag	aat	atc	aat	ctg	cgc	cat	gag	att	tcg	gcg	atg	gct	gct	cat	tgg	787	
Lys	Asn	Ile	Asn	Leu	Arg	His	Glu	Ile	Ser	Ala	Met	Ala	Ala	His	Trp		
	215					220					225						
cgg	aat	cct	cgt	ttg	gcg	ttg	ctt	ttt	ggt	act	gcg	ttt	ttg	ggc	atg	835	
Arg	Asn	Pro	Arg	Leu	Ala	Leu	Leu	Phe	Gly	Thr	Ala	Phe	Leu	Gly	Met		
230				235						240				245			
ggt	act	ttt	gtg	tcg	ctg	tac	aac	tat	ttg	ggt	ttc	cgc	atg	att	gat	883	
Gly	Thr	Phe	Val	Ser	Leu	Tyr	Asn	Tyr	Leu	Gly	Phe	Arg	Met	Ile	Asp		

250										255					260					
cag	ttt	ggg	ctg	agt	gaa	gtg	ctg	gtt	ggg	gcg	gtg	ttc	atc	atg	tat	931				
Gln	Phe	Gly	Leu	Ser	Glu	Val	Leu	Val	Gly	Ala	Val	Phe	Ile	Met	Tyr					
			265						270					275						
ctg	gcc	ggg	acc	tgg	agt	tcc	acc	cag	gcg	ggg	gcg	ttg	agg	gag	aag	979				
Leu	Ala	Gly	Thr	Trp	Ser	Ser	Thr	Gln	Ala	Gly	Ala	Leu	Arg	Glu	Lys					
		280					285					290								
atc	ggc	aat	ggg	tca	acg	gtt	att	ttc	ttg	agt	ctg	acg	atg	atc	gcg	1027				
Ile	Gly	Asn	Gly	Ser	Thr	Val	Ile	Phe	Leu	Ser	Leu	Thr	Met	Ile	Ala					
	295					300					305									
tcg	atg	gca	ctg	atg	ggg	att	aat	aat	ttg	tgg	gtc	acg	ttg	gtt	gcc	1075				
Ser	Met	Ala	Leu	Met	Gly	Ile	Asn	Asn	Leu	Trp	Val	Thr	Leu	Val	Ala					
310					315					320					325					
ctg	ttt	gtg	ttt	acc	gcg	gca	ttt	ttc	gca	ctg	cat	tcc	agt	gct	tcg	1123				
Leu	Phe	Val	Phe	Thr	Ala	Ala	Phe	Phe	Ala	Leu	His	Ser	Ser	Ala	Ser					
				330					335					340						
gga	tgg	atc	gga	atc	atc	gca	acg	aag	gat	cgc	gcg	gaa	gcc	tcc	agc	1171				
Gly	Trp	Ile	Gly	Ile	Ile	Ala	Thr	Lys	Asp	Arg	Ala	Glu	Ala	Ser	Ser					
			345					350					355							
atg	tat	ttg	ttc	tgt	gaa	tac	taggatcctc	gggtgattggt	tggtgattggt	tggtgattggt	tggtgattggt	tggtgattggt	tggtgattggt	tggtgattggt	tggtgattggt	1215				
Met	Tyr	Leu	Phe	Cys	Glu	Tyr														
			360																	

&lt;210&gt; 208

&lt;211&gt; 364

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 208

Met	Ser	Gln	Ala	Ile	Asp	Ser	Lys	Val	Glu	Ala	His	Glu	Gly	His	Glu
1				5					10					15	

Gly	His	Glu	Gly	Ile	Glu	Arg	Gly	Thr	Arg	Asn	Tyr	Lys	Arg	Ala	Val
		20					25						30		

Phe	Ala	Met	Leu	Ala	Ala	Gly	Leu	Ala	Ala	Phe	Asn	Gly	Leu	Tyr	Cys
		35					40					45			

Thr	Gln	Ala	Leu	Leu	Pro	Thr	Met	Thr	Glu	Glu	Leu	Gly	Ile	Thr	Pro
	50					55					60				

Thr	Glu	Ser	Ala	Leu	Thr	Val	Ser	Ala	Thr	Thr	Gly	Met	Leu	Ala	Leu
	65				70					75				80	

Cys	Ile	Val	Pro	Ala	Ser	Ile	Leu	Ser	Glu	Lys	Phe	Gly	Arg	Gly	Arg
				85					90					95	

Val	Leu	Thr	Ile	Ser	Leu	Thr	Leu	Ala	Ile	Ile	Val	Gly	Leu	Ile	Leu
			100					105					110		

Pro Leu Val Pro Asn Ile Thr Ala Leu Ile Leu Leu Arg Gly Leu Gln  
 115 120 125  
 Gly Ala Leu Leu Ala Gly Thr Pro Ala Val Ala Met Thr Trp Leu Ser  
 130 135 140  
 Glu Glu Ile His Pro Lys Asp Ile Gly His Ala Met Gly Ile Tyr Ile  
 145 150 155 160  
 Ala Gly Asn Thr Val Gly Gly Leu Thr Gly Arg Met Ile Pro Ala Gly  
 165 170 175  
 Leu Leu Glu Val Thr His Trp Gln Asn Ala Leu Leu Gly Ser Ser Ile  
 180 185 190  
 Ala Ala Leu Ile Phe Gly Val Ile Met Val Val Leu Leu Pro Lys Gln  
 195 200 205  
 Arg Lys Phe Gln Pro Lys Asn Ile Asn Leu Arg His Glu Ile Ser Ala  
 210 215 220  
 Met Ala Ala His Trp Arg Asn Pro Arg Leu Ala Leu Leu Phe Gly Thr  
 225 230 235 240  
 Ala Phe Leu Gly Met Gly Thr Phe Val Ser Leu Tyr Asn Tyr Leu Gly  
 245 250 255  
 Phe Arg Met Ile Asp Gln Phe Gly Leu Ser Glu Val Leu Val Gly Ala  
 260 265 270  
 Val Phe Ile Met Tyr Leu Ala Gly Thr Trp Ser Ser Thr Gln Ala Gly  
 275 280 285  
 Ala Leu Arg Glu Lys Ile Gly Asn Gly Ser Thr Val Ile Phe Leu Ser  
 290 295 300  
 Leu Thr Met Ile Ala Ser Met Ala Leu Met Gly Ile Asn Asn Leu Trp  
 305 310 315 320  
 Val Thr Leu Val Ala Leu Phe Val Phe Thr Ala Ala Phe Phe Ala Leu  
 325 330 335  
 His Ser Ser Ala Ser Gly Trp Ile Gly Ile Ile Ala Thr Lys Asp Arg  
 340 345 350  
 Ala Glu Ala Ser Ser Met Tyr Leu Phe Cys Glu Tyr  
 355 360

<210> 209  
 <211> 1572  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS



&lt;222&gt; (101)..(1549)

&lt;223&gt; RXN00034

&lt;400&gt; 209

taaattttgt ggcaactcccc acattttctat caatctatatag aaagtatgac ttaaagtcga 60

ttttgcaagt ttctatatagat tgatagaaaaa gggagtttag atg tct tac aca tct 115  
 Met Ser Tyr Thr Ser  
 1 5

ttt aaa ggc gat gat aaa gcc ctc atc ggc ata gtt tta tca gtt ctc 163  
 Phe Lys Gly Asp Asp Lys Ala Leu Ile Gly Ile Val Leu Ser Val Leu  
 10 15 20

aca ttt tgg ctt ttt gct cag tca acc cta aat atc ggc cca gat atg 211  
 Thr Phe Trp Leu Phe Ala Gln Ser Thr Leu Asn Ile Gly Pro Asp Met  
 25 30 35

gca act gat tta ggg atg agc gat ggc acc atg aac ata gct gtc gtg 259  
 Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met Asn Ile Ala Val Val  
 40 45 50

gcc gcc gcg tta ttc tgt gga aca ttt atc gtc gca gcc ggc ggc atc 307  
 Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val Ala Ala Gly Gly Ile  
 55 60 65

gca gat gtc ttt ggc cga gta cga atc atg atg att ggc aac atc ctt 355  
 Ala Asp Val Phe Gly Arg Val Arg Ile Met Met Ile Gly Asn Ile Leu  
 70 75 80 85

aac atc ctg gga tct ctc ctc atc gcc acg gca acg act tct tta gcc 403  
 Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala Thr Thr Ser Leu Ala  
 90 95 100

acc caa atg gtg atc acc ggc cga gtt ctc caa gga ctg gca gca gcg 451  
 Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln Gly Leu Ala Ala Ala  
 105 110 115

gcc atc atg tct gca tcc cta gca tta gtt aag aca tat tgg tta ggt 499  
 Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys Thr Tyr Trp Leu Gly  
 120 125 130

act gac cgc caa cga gca gtc tcc att tgg tcc att ggt tca tgg ggt 547  
 Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser Ile Gly Ser Trp Gly  
 135 140 145

ggc acc gga ttc tgc gcg ctt ttc gcg ggt ctt gtt gta gca agc ccc 595  
 Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu Val Val Ala Ser Pro  
 150 155 160 165

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 Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala Ile Val Ser Ile Val  
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gct att gcc ctt acc cgc cac atc ccg gaa tcc cgt ccg gct caa tcc 691  
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 185 190 195

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ggc ctc gga ctc ttc gcc acc cca gtc acc gat act gcg ctt gga aca Gly Leu Gly Leu Phe Ala Thr Pro Val Thr Asp Thr Ala Leu Gly Thr 375 380 385	1267
ctt ccc aaa gac cgt acc ggc gct ggt gca ggt gta ttc aag atg tcc Leu Pro Lys Asp Arg Thr Gly Ala Gly Ala Gly Val Phe Lys Met Ser 390 395 400 405	1315
tct tcc ctc ggc gca gca ctc ggc atc gca atc tcc act tca gtg ttc Ser Ser Leu Gly Ala Ala Leu Gly Ile Ala Ile Ser Thr Ser Val Phe 410 415 420	1363

ctc gca ctt cgc gac ggc acc tcc atc aac tcc gac gtc gca ctc gcc 1411  
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gga aca gtt tca ctt ggc atc aac gtt gta ttc gca gca aca gcc acc 1459  
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atc acc gca gca gtc ctt att cca aaa gcc gct ggc aaa gtc tca caa 1507  
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 <213> Corynebacterium glutamicum

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                   20                                  25                                  30

Ile Gly Pro Asp Met Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met  
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Asn Ile Ala Val Val Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val  
                   50                                  55                                  60

Ala Ala Gly Gly Ile Ala Asp Val Phe Gly Arg Val Arg Ile Met Met  
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Ile Gly Asn Ile Leu Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala  
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Thr Thr Ser Leu Ala Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln  
                   100                                  105                                  110

Gly Leu Ala Ala Ala Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys  
                   115                                  120                                  125

Thr Tyr Trp Leu Gly Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser  
   130                                  135                                  140

Ile Gly Ser Trp Gly Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu  
 145                                  150                                  155                                  160

Val Val Ala Ser Pro Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala  
                   165                                  170                                  175

Ile Val Ser Ile Val Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser  
 180 185 190  
 Arg Pro Ala Gln Ser Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile  
 195 200 205  
 Val Leu Ala Leu Ser Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly  
 210 215 220  
 Glu Ser Leu Gly Trp Thr His Trp Met Thr Trp Thr Leu Leu Ala Val  
 225 230 235 240  
 Ser Leu Thr Phe Leu Ala Val Phe Val Phe Ile Glu Arg Ile Ala Ser  
 245 250 255  
 Trp Pro Val Leu Asp Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly  
 260 265 270  
 Ala Thr Ile Thr Asn Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala  
 275 280 285  
 Val Val Met Trp Val Gln Gln Met Gly Trp Gly Val Ser Pro Thr Ile  
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 Ser Gly Leu Thr Ser Ile Gly Phe Ala Ala Phe Val Ile Leu Phe Ile  
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 Arg Val Gly Glu Lys Ala Met Gln Lys Val Gly Ala Arg Ala Val Ile  
 325 330 335  
 Ile Thr Ala Gly Ile Leu Val Ala Thr Ala Thr Ala Leu Leu Met Ile  
 340 345 350  
 Thr Ala Val Ser Glu Ser Thr Tyr Ile Val Ile Ser Leu Ala Gly Phe  
 355 360 365  
 Ser Leu Tyr Gly Leu Gly Leu Gly Leu Phe Ala Thr Pro Val Thr Asp  
 370 375 380  
 Thr Ala Leu Gly Thr Leu Pro Lys Asp Arg Thr Gly Ala Gly Ala Gly  
 385 390 395 400  
 Val Phe Lys Met Ser Ser Ser Leu Gly Ala Ala Leu Gly Ile Ala Ile  
 405 410 415  
 Ser Thr Ser Val Phe Leu Ala Leu Arg Asp Gly Thr Ser Ile Asn Ser  
 420 425 430  
 Asp Val Ala Leu Ala Gly Thr Val Ser Leu Gly Ile Asn Val Val Phe  
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 Ala Ala Thr Ala Thr Ile Thr Ala Ala Val Leu Ile Pro Lys Ala Ala  
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 Gly Lys Val Ser Gln Thr Ser Ile Thr Leu Pro Glu Pro Ala Ile Ala  
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Val Lys Ile

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<223> FRXA02273
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Met Ser Tyr Thr Ser 5															
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ttt aaa ggc gat gat aaa gcc ctc atc ggc ata gtt tta tca gtt ctc 163															
Phe Lys Gly Asp Asp Lys Ala Leu Ile Gly Ile Val Leu Ser Val Leu 20															
10 15															
aca ttt tgg ctt ttt gct cag tca acc cta aat atc ggc cca gat atg 211															
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25 30															
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Ala Asp Val Phe Gly Arg Val Arg Ile Met Met Ile Gly Asn Ile Leu 85															
70 75 80															
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Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln Gly Leu Ala Ala Ala 115															
105 110															
gcc atc atg tct gca tcc cta gca tta gtt aag aca tat tgg tta ggt 499															
Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys Thr Tyr Trp Leu Gly 130															
120 125															
act gac cgc caa cga gca gtc tcc att tgg tcc att ggt tca tgg ggt 547															
Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser Ile Gly Ser Trp Gly 145															
135 140															

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 Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu Val Val Ala Ser Pro  
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 ttt ggt tgg aga gga atc ttc gcc ctc tgc gcg atc gtc tcc atc gtt 643  
 Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala Ile Val Ser Ile Val  
 170 175 180  
  
 gct att gcc ctt acc cgc cac atc ccg gaa tcc cgt ccg gct caa tcc 691  
 Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser Arg Pro Ala Gln Ser  
 185 190 195  
  
 att ggc atg cat ttg gat tgg agt ggc atc atc gtt ctt gcc ctc agt 739  
 Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile Val Leu Ala Leu Ser  
 200 205 210  
  
 gtt cta tct ctt gaa ttg ttt att acc caa ggt gaa tca ctt ggc tgg 787  
 Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly Glu Ser Leu Gly Trp  
 215 220 225  
  
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 Thr His Trp Met Thr Trp Thr Leu Leu Ala Val Ser Leu Thr Phe Leu  
 230 235 240 245  
  
 gca gtt ttc gtc ttc att gaa cgc atc gcc agc tgg cca gtt ctc gac 883  
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 250 255 260  
  
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 Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly Ala Thr Ile Thr Asn  
 265 270 275  
  
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 Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala Val Val Met Trp Val  
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Ile Gly Pro Asp Met Ala Thr Asp Leu Gly Met Ser Asp Gly Thr Met  
 35 40 45  
 Asn Ile Ala Val Val Ala Ala Ala Leu Phe Cys Gly Thr Phe Ile Val  
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 Ala Ala Gly Gly Ile Ala Asp Val Phe Gly Arg Val Arg Ile Met Met  
 65 70 75 80  
 Ile Gly Asn Ile Leu Asn Ile Leu Gly Ser Leu Leu Ile Ala Thr Ala  
 85 90 95  
 Thr Thr Ser Leu Ala Thr Gln Met Val Ile Thr Gly Arg Val Leu Gln  
 100 105 110  
 Gly Leu Ala Ala Ala Ala Ile Met Ser Ala Ser Leu Ala Leu Val Lys  
 115 120 125  
 Thr Tyr Trp Leu Gly Thr Asp Arg Gln Arg Ala Val Ser Ile Trp Ser  
 130 135 140  
 Ile Gly Ser Trp Gly Gly Thr Gly Phe Cys Ala Leu Phe Ala Gly Leu  
 145 150 155 160  
 Val Val Ala Ser Pro Phe Gly Trp Arg Gly Ile Phe Ala Leu Cys Ala  
 165 170 175  
 Ile Val Ser Ile Val Ala Ile Ala Leu Thr Arg His Ile Pro Glu Ser  
 180 185 190  
 Arg Pro Ala Gln Ser Ile Gly Met His Leu Asp Trp Ser Gly Ile Ile  
 195 200 205  
 Val Leu Ala Leu Ser Val Leu Ser Leu Glu Leu Phe Ile Thr Gln Gly  
 210 215 220  
 Glu Ser Leu Gly Trp Thr His Trp Met Thr Trp Thr Leu Leu Ala Val  
 225 230 235 240  
 Ser Leu Thr Phe Leu Ala Val Phe Val Phe Ile Glu Arg Ile Ala Ser  
 245 250 255  
 Trp Pro Val Leu Asp Phe Asn Leu Phe Lys Asp His Ala Phe Ser Gly  
 260 265 270  
 Ala Thr Ile Thr Asn Phe Ile Met Ser Ala Thr Gly Gly Val Val Ala  
 275 280 285  
 Val Val Met Trp Val Gln Gln Met Gly Trp Gly Val Ser Pro Thr Ile  
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&lt;210&gt; 213



&lt;211&gt; 826

&lt;212&gt; DNA

<213> *Corynebacterium glutamicum*

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(826)

&lt;223&gt; RXN03075

&lt;400&gt; 213

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                                         Val Ala Lys Phe Leu
                                         1                               5

tat aag tta ggc tcc acg gcc tat caa aag aaa tgg ccg ttt ctt gcg 163
Tyr Lys Leu Gly Ser Thr Ala Tyr Gln Lys Lys Trp Pro Phe Leu Ala
                        10                        15                        20

gtc tgg ctc gtg att ctc ata ggt atc acg acg ctg gcg ggg ctg tat 211
Val Trp Leu Val Ile Leu Ile Gly Ile Thr Thr Leu Ala Gly Leu Tyr
                        25                        30                        35

gcc aag cca acg tcg agt agc ttc tct atc cct ggt ctt gat tct gtc 259
Ala Lys Pro Thr Ser Ser Ser Phe Ser Ile Pro Gly Leu Asp Ser Val
                        40                        45                        50

acg acc atg gag aag atg cag gag cgt ttc cct ggt tcg gat gat gca 307
Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro Gly Ser Asp Asp Ala
                        55                        60                        65

aca tcg gct ccc act ggt tct gtc gtc att cag gca ccg gaa ggc aag 355
Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln Ala Pro Glu Gly Lys
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acc ctc act gat cct gag gtt ggg gct gaa gta aac cag atg ctt gat 403
Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val Asn Gln Met Leu Asp
                        90                        95                        100

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Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala Asp Ser Val Val Asp
                        105                        110                        115

cct gtg ttg gct gcg cag ggt gtg gct gct cag atg acc cca gcc ctg 499
Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln Met Thr Pro Ala Leu
                        120                        125                        130

gag gct cag ggt gta cct gcg gag aag atc gcc gca gat att gag tcg 547
Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala Ala Asp Ile Glu Ser
                        135                        140                        145

att agt cca ctg agt gca gat gag act acc ggc atc atc tcg atg act 595
Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly Ile Ile Ser Met Thr
150                        155                        160                        165

ttt gat gca gat tct gcc atg gat ata tcc gca gag gat cgt gag aag 643

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Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala Glu Asp Arg Glu Lys  
 170 175 180

gtc acc aat att ctt gat gaa tac gat gac ggc gat ctg act gtt gtc 691  
 Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly Asp Leu Thr Val Val  
 185 190 195

tac aac ggc aac gtg ttt ggc gca gct gca acc agc ttg gac atg acc 739  
 Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr Ser Leu Asp Met Thr  
 200 205 210

tct gag ctc atc ggc ctg ctg gtg gct gcg gtc gtt ctt atc gtg acc 787  
 Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val Val Leu Ile Val Thr  
 215 220 225

ttc ggt tcg ttc atc gct gcc ggt atg ccg ctg atc tct 826  
 Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu Ile Ser  
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<211> 242

<212> PRT

<213> Corynebacterium glutamicum

<400> 214

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 20 25 30

Leu Ala Gly Leu Tyr Ala Lys Pro Thr Ser Ser Ser Phe Ser Ile Pro  
 35 40 45

Gly Leu Asp Ser Val Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro  
 50 55 60

Gly Ser Asp Asp Ala Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln  
 65 70 75 80

Ala Pro Glu Gly Lys Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val  
 85 90 95

Asn Gln Met Leu Asp Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala  
 100 105 110

Asp Ser Val Val Asp Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln  
 115 120 125

Met Thr Pro Ala Leu Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala  
 130 135 140

Ala Asp Ile Glu Ser Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly  
 145 150 155 160

Ile Ile Ser Met Thr Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala

	165		170		175
Glu Asp Arg	Glu Lys Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly				
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Asp Leu Thr Val Val Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr					
	195		200		205
Ser Leu Asp Met Thr Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val					
	210		215		220
Val Leu Ile Val Thr Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu					
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Ile Ser

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 Val Ala Lys Phe Leu 5  
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 tat aag tta ggc tcc acg gcc tat caa aag aaa tgg ccg ttt ctt gcg 163  
 Tyr Lys Leu Gly Ser Thr Ala Tyr Gln Lys Lys Trp Pro Phe Leu Ala 20  
 10 15  
 gtc tgg ctc gtg att ctc ata ggt atc acg acg ctg gcg ggg ctg tat 211  
 Val Trp Leu Val Ile Leu Ile Gly Ile Thr Thr Leu Ala Gly Leu Tyr 35  
 25 30  
 gcc aag cca acg tcg agt agc ttc tct atc cct ggt ctt gat tct gtc 259  
 Ala Lys Pro Thr Ser Ser Ser Phe Ser Ile Pro Gly Leu Asp Ser Val 50  
 40 45  
 acg acc atg gag aag atg cag gag cgt ttc cct ggt tcg gat gat gca 307  
 Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro Gly Ser Asp Asp Ala 65  
 55 60  
 aca tcg gct ccc act ggt tct gtc gtc att cag gca ccg gaa ggc aag 355  
 Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln Ala Pro Glu Gly Lys 85  
 70 75 80  
 acc ctc act gat cct gag gtt ggg gct gaa gta aac cag atg ctt gat 403  
 Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val Asn Gln Met Leu Asp

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Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala Asp Ser Val Val Asp				
	105	110	115	
cct gtg ttg gct gcg cag ggt gtg gct gct cag atg acc cca gcc ctg				499
Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln Met Thr Pro Ala Leu				
	120	125	130	
gag gct cag ggt gta cct gcg gag aag atc gcc gca gat att gag tcg				547
Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala Ala Asp Ile Glu Ser				
	135	140	145	
att agt cca ctg agt gca gat gag act acc ggc atc atc tcg atg act				595
Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly Ile Ile Ser Met Thr				
	150	155	160	165
ttt gat gca gat tct gcc atg gat ata tcc gca gag gat cgt gag aag				643
Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala Glu Asp Arg Glu Lys				
	170	175	180	
gtc acc aat att ctt gat gaa tac gat gac ggc gat ctg act gtt gtc				691
Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly Asp Leu Thr Val Val				
	185	190	195	
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Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr Ser Leu Asp Met Thr				
	200	205	210	
tct gag ctc atc ggc ctg ctg gtg gct gcg gtc gtt ctt atc gtg acc				787
Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val Val Leu Ile Val Thr				
	215	220	225	
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Phe Gly Ser Phe Ile Ala Ala Gly Met Pro Leu Ile Ser				
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 Gly Leu Asp Ser Val Thr Thr Met Glu Lys Met Gln Glu Arg Phe Pro  
 50 55 60

Gly Ser Asp Asp Ala Thr Ser Ala Pro Thr Gly Ser Val Val Ile Gln  
 65 70 75 80  
 Ala Pro Glu Gly Lys Thr Leu Thr Asp Pro Glu Val Gly Ala Glu Val  
 85 90 95  
 Asn Gln Met Leu Asp Glu Val Arg Ala Thr Gly Val Leu Lys Asp Ala  
 100 105 110  
 Asp Ser Val Val Asp Pro Val Leu Ala Ala Gln Gly Val Ala Ala Gln  
 115 120 125  
 Met Thr Pro Ala Leu Glu Ala Gln Gly Val Pro Ala Glu Lys Ile Ala  
 130 135 140  
 Ala Asp Ile Glu Ser Ile Ser Pro Leu Ser Ala Asp Glu Thr Thr Gly  
 145 150 155 160  
 Ile Ile Ser Met Thr Phe Asp Ala Asp Ser Ala Met Asp Ile Ser Ala  
 165 170 175  
 Glu Asp Arg Glu Lys Val Thr Asn Ile Leu Asp Glu Tyr Asp Asp Gly  
 180 185 190  
 Asp Leu Thr Val Val Tyr Asn Gly Asn Val Phe Gly Ala Ala Ala Thr  
 195 200 205  
 Ser Leu Asp Met Thr Ser Glu Leu Ile Gly Leu Leu Val Ala Ala Val  
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 Met Ser Thr Ser Ile  
 1 5  
 aca aca gag aac aag aag aaa tct ggt cct cct cgc ttg atg aga atc 163  
 Thr Thr Glu Asn Lys Lys Lys Ser Gly Pro Pro Arg Leu Met Arg Ile  
 10 15 20

ttt ctg ccc gcc ttg cta att tta gtt tgg ctt gta gga gct gga gtc	211
Phe Leu Pro Ala Leu Leu Ile Leu Val Trp Leu Val Gly Ala Gly Val	
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ggc ggt cct tat ttt ggc aag gtt agt gag gtc tcc tcc aac agc cag	259
Gly Gly Pro Tyr Phe Gly Lys Val Ser Glu Val Ser Ser Asn Ser Gln	
40 45 50	
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Thr Thr Tyr Leu Pro Glu Ser Ala Asp Ala Thr Gln Val Gln Glu Gln	
55 60 65	
ttg gga gat ttt act gat tct gaa tcc atc cca gcc att gtc gta atg	355
Leu Gly Asp Phe Thr Asp Ser Glu Ser Ile Pro Ala Ile Val Val Met	
70 75 80 85	
gtc agc gat gaa ccc tta aca cag caa gac atc aca caa ctc aat gaa	403
Val Ser Asp Glu Pro Leu Thr Gln Gln Asp Ile Thr Gln Leu Asn Glu	
90 95 100	
gtt gtt gct ggg ctt tca gaa tta gac ata gtt tcc gat gaa gtc tcc	451
Val Val Ala Gly Leu Ser Glu Leu Asp Ile Val Ser Asp Glu Val Ser	
105 110 115	
cct gct att cca tcc gag gac ggc aga gct gtc caa gtg ttt gtc ccc	499
Pro Ala Ile Pro Ser Glu Asp Gly Arg Ala Val Gln Val Phe Val Pro	
120 125 130	
ctc aat cca tca gcg gag ctg acg gaa agc gtc gag aag ctc tct gag	547
Leu Asn Pro Ser Ala Glu Leu Thr Glu Ser Val Glu Lys Leu Ser Glu	
135 140 145	
acc ttg acc cag caa acg ccg gac tat gtg agc acc tat gtg acc gga	595
Thr Leu Thr Gln Gln Thr Pro Asp Tyr Val Ser Thr Tyr Val Thr Gly	
150 155 160 165	
ccg gct ggg ttt acc gct gat ctc agc gca gct ttc gcg ggt att gat	643
Pro Ala Gly Phe Thr Ala Asp Leu Ser Ala Ala Phe Ala Gly Ile Asp	
170 175 180	
ggg cta ctc cta gca gtc gcc ttg gct gcc gtc ctt gtc att ctt gtc	691
Gly Leu Leu Leu Ala Val Ala Leu Ala Val Leu Val Ile Leu Val	
185 190 195	
atc gtc tat cgc tcc ttc att ctg ccc atc gcc gtg ctt gcc acc agt	739
Ile Val Tyr Arg Ser Phe Ile Leu Pro Ile Ala Val Leu Ala Thr Ser	
200 205 210	
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Leu Phe Ala Leu Thr Val Ala Leu Leu Val Val Trp Trp Leu Ala Lys	
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Trp Asp Ile Leu Leu Ser Gly Gln Thr Gln Gly Ile Leu Phe Ile	
230 235 240 245	

ctg gtc att ggc gcc gcc acc gac tac tca ttg cta tac gtt gct cgt	883
Leu Val Ile Gly Ala Ala Thr Asp Tyr Ser Leu Leu Tyr Val Ala Arg	
250 255 260	
ttc cgt gaa gag tta cgc gtt caa caa gat aaa ggg ata gcc aca ggg	931
Phe Arg Glu Glu Leu Arg Val Gln Gln Asp Lys Gly Ile Ala Thr Gly	
265 270 275	
aaa gcc atc cgg gca tcg gtg gaa ccc att ctt gcc tcg ggc agc act	979
Lys Ala Ile Arg Ala Ser Val Glu Pro Ile Leu Ala Ser Gly Ser Thr	
280 285 290	
gtt att gcg ggc ctc ctt tgt ttg cta ttt agt gat ttg aaa tct aac	1027
Val Ile Ala Gly Leu Leu Cys Leu Leu Phe Ser Asp Leu Lys Ser Asn	
295 300 305	
tcc acg cta ggt cca gta gct tcg gtg ggc att att ttt gca atg ctt	1075
Ser Thr Leu Gly Pro Val Ala Ser Val Gly Ile Ile Phe Ala Met Leu	
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Ser Ala Leu Thr Leu Leu Pro Ala Leu Leu Phe Val Phe Gly Arg Val	
330 335 340	
gcc ttt tgg ccc aag cga cca aaa tac gaa cct gaa aaa gcc cgt gcg	1171
Ala Phe Trp Pro Lys Arg Pro Lys Tyr Glu Pro Glu Lys Ala Arg Ala	
345 350 355	
aaa aac gac atc ccc gcc agc ggg atc tgg tca aaa gtg gct gat tta	1219
Lys Asn Asp Ile Pro Ala Ser Gly Ile Trp Ser Lys Val Ala Asp Leu	
360 365 370	
gtg gag cag cat cct cgt gca atc tgg gta tct aca ctt att gtg ctt	1267
Val Glu Gln His Pro Arg Ala Ile Trp Val Ser Thr Leu Ile Val Leu	
375 380 385	
ctc ttg ggt gcg gct ttc gtt ccc aca cta aaa gcg gac ggt gtg tcc	1315
Leu Leu Gly Ala Ala Phe Val Pro Thr Leu Lys Ala Asp Gly Val Ser	
390 395 400 405	
caa tcc gac cta gtt ctg ggt tcc tct gaa gca cgt gat ggc cag cag	1363
Gln Ser Asp Leu Val Leu Gly Ser Ser Glu Ala Arg Asp Gly Gln Gln	
410 415 420	
gct tta ggc gaa cac ttc ccc ggt gga tcc ggc agt cct gct tat att	1411
Ala Leu Gly Glu His Phe Pro Gly Gly Ser Gly Ser Pro Ala Tyr Ile	
425 430 435	
atc gtt gat gaa aca cag gca gca cag gct gct gac gta gtc ctt aac	1459
Ile Val Asp Glu Thr Gln Ala Ala Gln Ala Ala Asp Val Val Leu Asn	
440 445 450	
aac gac aat ttc gag act gta act gta act agt gct gac tcc ccc tct	1507
Asn Asp Asn Phe Glu Thr Val Thr Val Thr Ser Ala Asp Ser Pro Ser	
455 460 465	
ggc tca gcc cca atc acc gct gac ggt att gtg ccg tta ggt tct ggt	1555



Gly 470	Ser	Ala	Pro	Ile	Thr 475	Ala	Asp	Gly	Ile	Val 480	Pro	Leu	Gly	Ser	Gly 485	
aca gct cca ggc ccg gta gtt gta gaa ggg caa gtc ctt tta caa gca	1603															
Thr Ala Pro Gly Pro Val Val Val Glu Gly Gln Val Leu Leu Gln Ala																
	490	495	500													
aca ctt gtc gaa gca cca gat tcc gaa gaa gct caa aaa gct att cgc	1651															
Thr Leu Val Glu Ala Pro Asp Ser Glu Glu Ala Gln Lys Ala Ile Arg																
	505	510	515													
agt atc cgc caa act ttt gca gat gaa aat ata tca gcg gta gta ggc	1699															
Ser Ile Arg Gln Thr Phe Ala Asp Glu Asn Ile Ser Ala Val Val Gly																
	520	525	530													
ggt gtc act gca act tcc gta gac act aac gat gcc tcc atc cat gac	1747															
Gly Val Thr Ala Thr Ser Val Asp Thr Asn Asp Ala Ser Ile His Asp																
	535	540	545													
cgc aac ctg atc atc cca att gta ttg ctg gtc att ttg gtt att ctc	1795															
Arg Asn Leu Ile Ile Pro Ile Val Leu Leu Val Ile Leu Val Ile Leu																
	550	555	560	565												
atg ctg ttg ctg cgg tct att gtc gca cca ctc ctg cta gta gtc acc	1843															
Met Leu Leu Leu Arg Ser Ile Val Ala Pro Leu Leu Leu Val Val Thr																
	570	575	580													
acc gtg gtg tct ttt gct act gct tta ggc gtg gct gct tta ctt ttc	1891															
Thr Val Val Ser Phe Ala Thr Ala Leu Gly Val Ala Ala Leu Leu Phe																
	585	590	595													
aat cac gtt ttc agt ttc cca gga gca gac ccc gca gta cct ctc tac	1939															
Asn His Val Phe Ser Phe Pro Gly Ala Asp Pro Ala Val Pro Leu Tyr																
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gga ttt gta ttt tta gta gcc ttg ggc atc gac tac aac att ttc tta	1987															
Gly Phe Val Phe Leu Val Ala Leu Gly Ile Asp Tyr Asn Ile Phe Leu																
	615	620	625													
gtc acc cga atc cgt gaa gaa acc aaa acc cac ggc aca aga ctt gga	2035															
Val Thr Arg Ile Arg Glu Glu Thr Lys Thr His Gly Thr Arg Leu Gly																
	630	635	640	645												
att ctt cga ggc ctg aca gta acc ggc gga gta att acc tca gct gga	2083															
Ile Leu Arg Gly Leu Thr Val Thr Gly Gly Val Ile Thr Ser Ala Gly																
	650	655	660													
gta gtt ctc gcc gca acg ttc gca gca ctc tat gtc atc cca att cta	2131															
Val Val Leu Ala Ala Thr Phe Ala Ala Leu Tyr Val Ile Pro Ile Leu																
	665	670	675													
ttc ctg gca caa att gcc ttc att gtc gct ttt gga gtt ctt att gat	2179															
Phe Leu Ala Gln Ile Ala Phe Ile Val Ala Phe Gly Val Leu Ile Asp																
	680	685	690													
acc ctg ctc gtt cgc gcc ttc ttg gtg cct gct ttg ttc tac gac atc	2227															
Thr Leu Leu Val Arg Ala Phe Leu Val Pro Ala Leu Phe Tyr Asp Ile																

695

700

705

gga ccg aaa atc tgg tgg ccg tca aaa ttg tcc aat cag aaa tac cag 2275  
 Gly Pro Lys Ile Trp Trp Pro Ser Lys Leu Ser Asn Gln Lys Tyr Gln  
 710 715 720 725

aag cag cct cag cta tgacacacca aaattcgct ctc 2313  
 Lys Gln Pro Gln Leu  
 730

&lt;210&gt; 218

&lt;211&gt; 730

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 218

Met Ser Thr Ser Ile Thr Thr Glu Asn Lys Lys Lys Ser Gly Pro Pro  
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Arg Leu Met Arg Ile Phe Leu Pro Ala Leu Leu Ile Leu Val Trp Leu  
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Val Gly Ala Gly Val Gly Gly Pro Tyr Phe Gly Lys Val Ser Glu Val  
 35 40 45

Ser Ser Asn Ser Gln Thr Thr Tyr Leu Pro Glu Ser Ala Asp Ala Thr  
 50 55 60

Gln Val Gln Glu Gln Leu Gly Asp Phe Thr Asp Ser Glu Ser Ile Pro  
 65 70 75 80

Ala Ile Val Val Met Val Ser Asp Glu Pro Leu Thr Gln Gln Asp Ile  
 85 90 95

Thr Gln Leu Asn Glu Val Val Ala Gly Leu Ser Glu Leu Asp Ile Val  
 100 105 110

Ser Asp Glu Val Ser Pro Ala Ile Pro Ser Glu Asp Gly Arg Ala Val  
 115 120 125

Gln Val Phe Val Pro Leu Asn Pro Ser Ala Glu Leu Thr Glu Ser Val  
 130 135 140

Glu Lys Leu Ser Glu Thr Leu Thr Gln Gln Thr Pro Asp Tyr Val Ser  
 145 150 155 160

Thr Tyr Val Thr Gly Pro Ala Gly Phe Thr Ala Asp Leu Ser Ala Ala  
 165 170 175

Phe Ala Gly Ile Asp Gly Leu Leu Leu Ala Val Ala Leu Ala Ala Val  
 180 185 190

Leu Val Ile Leu Val Ile Val Tyr Arg Ser Phe Ile Leu Pro Ile Ala  
 195 200 205

Val Leu Ala Thr Ser Leu Phe Ala Leu Thr Val Ala Leu Leu Val Val

210	215	220
Trp Trp Leu Ala Lys Trp Asp Ile Leu Leu Leu Ser Gly Gln Thr Gln 225 230 235 240		
Gly Ile Leu Phe Ile Leu Val Ile Gly Ala Ala Thr Asp Tyr Ser Leu 245 250 255		
Leu Tyr Val Ala Arg Phe Arg Glu Glu Leu Arg Val Gln Gln Asp Lys 260 265 270		
Gly Ile Ala Thr Gly Lys Ala Ile Arg Ala Ser Val Glu Pro Ile Leu 275 280 285		
Ala Ser Gly Ser Thr Val Ile Ala Gly Leu Leu Cys Leu Leu Phe Ser 290 295 300		
Asp Leu Lys Ser Asn Ser Thr Leu Gly Pro Val Ala Ser Val Gly Ile 305 310 315 320		
Ile Phe Ala Met Leu Ser Ala Leu Thr Leu Leu Pro Ala Leu Leu Phe 325 330 335		
Val Phe Gly Arg Val Ala Phe Trp Pro Lys Arg Pro Lys Tyr Glu Pro 340 345 350		
Glu Lys Ala Arg Ala Lys Asn Asp Ile Pro Ala Ser Gly Ile Trp Ser 355 360 365		
Lys Val Ala Asp Leu Val Glu Gln His Pro Arg Ala Ile Trp Val Ser 370 375 380		
Thr Leu Ile Val Leu Leu Leu Gly Ala Ala Phe Val Pro Thr Leu Lys 385 390 395 400		
Ala Asp Gly Val Ser Gln Ser Asp Leu Val Leu Gly Ser Ser Glu Ala 405 410 415		
Arg Asp Gly Gln Gln Ala Leu Gly Glu His Phe Pro Gly Gly Ser Gly 420 425 430		
Ser Pro Ala Tyr Ile Ile Val Asp Glu Thr Gln Ala Ala Gln Ala Ala 435 440 445		
Asp Val Val Leu Asn Asn Asp Asn Phe Glu Thr Val Thr Val Thr Ser 450 455 460		
Ala Asp Ser Pro Ser Gly Ser Ala Pro Ile Thr Ala Asp Gly Ile Val 465 470 475 480		
Pro Leu Gly Ser Gly Thr Ala Pro Gly Pro Val Val Val Glu Gly Gln 485 490 495		
Val Leu Leu Gln Ala Thr Leu Val Glu Ala Pro Asp Ser Glu Glu Ala 500 505 510		
Gln Lys Ala Ile Arg Ser Ile Arg Gln Thr Phe Ala Asp Glu Asn Ile		

515					520					525					
Ser	Ala	Val	Val	Gly	Gly	Val	Thr	Ala	Thr	Ser	Val	Asp	Thr	Asn	Asp
530						535					540				
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545					550					555					560
Ile	Leu	Val	Ile	Leu	Met	Leu	Leu	Leu	Arg	Ser	Ile	Val	Ala	Pro	Leu
				565					570					575	
Leu	Leu	Val	Val	Thr	Thr	Val	Val	Ser	Phe	Ala	Thr	Ala	Leu	Gly	Val
				580				585					590		
Ala	Ala	Leu	Leu	Phe	Asn	His	Val	Phe	Ser	Phe	Pro	Gly	Ala	Asp	Pro
		595					600					605			
Ala	Val	Pro	Leu	Tyr	Gly	Phe	Val	Phe	Leu	Val	Ala	Leu	Gly	Ile	Asp
610					615					620					
Tyr	Asn	Ile	Phe	Leu	Val	Thr	Arg	Ile	Arg	Glu	Glu	Thr	Lys	Thr	His
625					630					635					640
Gly	Thr	Arg	Leu	Gly	Ile	Leu	Arg	Gly	Leu	Thr	Val	Thr	Gly	Gly	Val
				645					650					655	
Ile	Thr	Ser	Ala	Gly	Val	Val	Leu	Ala	Ala	Thr	Phe	Ala	Ala	Leu	Tyr
				660				665						670	
Val	Ile	Pro	Ile	Leu	Phe	Leu	Ala	Gln	Ile	Ala	Phe	Ile	Val	Ala	Phe
		675					680					685			
Gly	Val	Leu	Ile	Asp	Thr	Leu	Leu	Val	Arg	Ala	Phe	Leu	Val	Pro	Ala
		690				695					700				
Leu	Phe	Tyr	Asp	Ile	Gly	Pro	Lys	Ile	Trp	Trp	Pro	Ser	Lys	Leu	Ser
705					710					715					720
Asn	Gln	Lys	Tyr	Gln	Lys	Gln	Pro	Gln	Leu						
				725					730						

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 <223> RXN03124

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Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln	
20 25 30	
act ggc gct aat gat ctg gag cca aag gaa ttg gct gag cgt ctg cgc	144
Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg	
35 40 45	
acc atg ccg ttg gct gct cgt gcg cat gcg atg gga atg gct gtg ggc	192
Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly	
50 55 60	
act gcg ggt tct gcg gtt gta ttc gcg ggt acc acg gtg ctg atc gct	240
Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala	
65 70 75 80	
ctg gtt gct ctg tcg atc att aat att cca ttt cta acc gtg atg gcc	288
Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala	
85 90 95	
att gct gcc gca atc acc gtt gcc atc gca gtt ctg gtt gct ctg tcc	336
Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser	
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ttc ctc cca gct ctg ctt ggc ctg ctt ggc act cgc atc ttc gca gca	384
Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala	
115 120 125	
cgc gtg cct gga cct aag gtt ccg gat cct gag gac gag aag cca acg	432
Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr	
130 135 140	
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Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr	
145 150 155 160	
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Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr	
165 170 175	
aat atg cgc ctg gcc atg ccg act gat ggc acc tcc acg ctg ggc acc	576
Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr	
180 185 190	
gcg ccg cgc acg ggg tat gac atg acg gca gat gcg ttc ggc ccg ggc	624
Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly	
195 200 205	
cgc aac gcg ccc atg att gcg ctt atc gac gca acc gac gtc cct gag	672
Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu	
210 215 220	
gaa gaa cgc cca ttg gtg ttt gga cag gcg gtg gag caa ttc ttg aac	720
Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn	
225 230 235 240	
act gat ggt gtg aag aat gct cag atc act cag acc acg gag aat ttc	768

Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu Asn Phe  
 245 250 255

gat acc gcg cag atc ctg tta ccc cag aat ttg atg cga tcg atg agc 816  
 Asp Thr Ala Gln Ile Leu Leu Pro Gln Asn Leu Met Arg Ser Met Ser  
 260 265 270

gca cct ctg aga ctc tcg caa ctc ttc gtg cag atg ctg aga cct tcg 864  
 Ala Pro Leu Arg Leu Ser Gln Leu Phe Val Gln Met Leu Arg Pro Ser  
 275 280 285

ctg atg aca ccg gcg cga cgt atg gca tta ctg gcg tca ccc caa ttt 912  
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 290 295 300

acg atg aca tct ctg ctc gcc tcg gcg acg tcc tgg ttc ctt acg ttc 960  
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 305 310 315 320

tgatcgtttt ggttctagcg ttc 983

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 <213> Corynebacterium glutamicum

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 20 25 30

Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg  
 35 40 45

Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly  
 50 55 60

Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala  
 65 70 75 80

Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala  
 85 90 95

Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser  
 100 105 110

Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala  
 115 120 125

Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr  
 130 135 140

Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr  
 145 150 155 160

Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr  
 165 170 175  
 Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr  
 180 185 190  
 Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly  
 195 200 205  
 Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu  
 210 215 220  
 Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn  
 225 230 235 240  
 Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu Asn Phe  
 245 250 255  
 Asp Thr Ala Gln Ile Leu Leu Pro Gln Asn Leu Met Arg Ser Met Ser  
 260 265 270  
 Ala Pro Leu Arg Leu Ser Gln Leu Phe Val Gln Met Leu Arg Pro Ser  
 275 280 285  
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 <213> Corynebacterium glutamicum

<220>  
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 <222> (1)..(762)  
 <223> FRXA01180

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 Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln  
 20 25 30  
 act ggc gct aat gat ctg gag cca aag gaa ttg gct gag cgt ctg cgc 144  
 Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg  
 35 40 45



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acc atg ccg ttg gct gct cgt gcg cat gcg atg gga atg gct gtg ggc 192
Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly
      50                55                60

act gcg ggt tct gcg gtt gta ttc gcg ggt acc acg gtg ctg atc gct 240
Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala
      65                70                75                80

ctg gtt gct ctg tcg atc att aat att cca ttt cta acc gtg atg gcc 288
Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala
                85                90                95

att gct gcc gca atc acc gtt gcc atc gca gtt ctg gtt gct ctg tcc 336
Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser
                100                105                110

ttc ctc cca gct ctg ctt ggc ctg ctt ggc act cgc atc ttc gca gca 384
Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala
                115                120                125

cgc gtg cct gga cct aag gtt ccg gat cct gag gac gag aag cca acg 432
Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr
      130                135                140

atg ggt ctg aag tgg gtc cgc ctt gtg cgc aag atg ccg gtg gct tac 480
Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr
      145                150                155                160

ctg ctg gtt ggc gtc gtt ttg ctt ggt gca atc gca att cct gcg acc 528
Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr
                165                170                175

aat atg cgc ctg gcc atg ccg act gat ggc acc tcc acg ctg ggc acc 576
Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr
                180                185                190

gcg ccg cgc acg ggg tat gac atg acg gca gat gcg ttc ggc ccg ggc 624
Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly
                195                200                205

cgc aac gcg ccc atg att gcg ctt atc gac gca acc gac gtc cct gag 672
Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu
      210                215                220

gaa gaa cgc cca ttg gtg ttt gga cag gcg gtg gag caa ttc ttg aac 720
Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn
      225                230                235                240

act gat ggt gtg aag aat gct cag atc act cag acc acg gag 762
Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu
                245                250

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&lt;210&gt; 222

&lt;211&gt; 254

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 222

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Met Thr Pro Thr Leu Ala Ser Met Ile Gly Leu Ala Val Gly Ile Asp
 1           5           10           15

Tyr Ala Leu Phe Ile Val Ser Arg Phe Arg Asn Glu Leu Ile Ser Gln
      20           25           30

Thr Gly Ala Asn Asp Leu Glu Pro Lys Glu Leu Ala Glu Arg Leu Arg
      35           40           45

Thr Met Pro Leu Ala Ala Arg Ala His Ala Met Gly Met Ala Val Gly
      50           55           60

Thr Ala Gly Ser Ala Val Val Phe Ala Gly Thr Thr Val Leu Ile Ala
      65           70           75           80

Leu Val Ala Leu Ser Ile Ile Asn Ile Pro Phe Leu Thr Val Met Ala
      85           90           95

Ile Ala Ala Ala Ile Thr Val Ala Ile Ala Val Leu Val Ala Leu Ser
      100          105          110

Phe Leu Pro Ala Leu Leu Gly Leu Leu Gly Thr Arg Ile Phe Ala Ala
      115          120          125

Arg Val Pro Gly Pro Lys Val Pro Asp Pro Glu Asp Glu Lys Pro Thr
      130          135          140

Met Gly Leu Lys Trp Val Arg Leu Val Arg Lys Met Pro Val Ala Tyr
      145          150          155          160

Leu Leu Val Gly Val Val Leu Leu Gly Ala Ile Ala Ile Pro Ala Thr
      165          170          175

Asn Met Arg Leu Ala Met Pro Thr Asp Gly Thr Ser Thr Leu Gly Thr
      180          185          190

Ala Pro Arg Thr Gly Tyr Asp Met Thr Ala Asp Ala Phe Gly Pro Gly
      195          200          205

Arg Asn Ala Pro Met Ile Ala Leu Ile Asp Ala Thr Asp Val Pro Glu
      210          215          220

Glu Glu Arg Pro Leu Val Phe Gly Gln Ala Val Glu Gln Phe Leu Asn
      225          230          235          240

Thr Asp Gly Val Lys Asn Ala Gln Ile Thr Gln Thr Thr Glu
      245          250

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&lt;210&gt; 223

&lt;211&gt; 393

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(370)

&lt;223&gt; RXA02586

&lt;400&gt; 223

ttctctgaga tcgtcatgat gaagtacatc gcgttcggca tgatecgcagc gctgattctg 60

gatgccacca tcattccgcat gctgcttgtc ccccgccgtg atg cac ctg ctt cgc 115  
 Met His Leu Leu Arg  
 1 5

gac gac aac tgg tgg gca ccc ggc ttc gtt aaa aag gcc tac acc gtc 163  
 Asp Asp Asn Trp Trp Ala Pro Gly Phe Val Lys Lys Ala Tyr Thr Val  
 10 15 20

atg ggt cac ggc tct gag gtg gag gaa gca cct cgc cca acc acc cgt 211  
 Met Gly His Gly Ser Glu Val Glu Glu Ala Pro Arg Pro Thr Thr Arg  
 25 30 35

cgc ctc aac gac gat gag gaa gtc acc gtg cat gaa gca gtt gtc gct 259  
 Arg Leu Asn Asp Asp Glu Glu Val Thr Val His Glu Ala Val Val Ala  
 40 45 50

ggc gat acc gtg gca tct cgc ggt ggt ttg agc acg cag gaa aac cgt 307  
 Gly Asp Thr Val Ala Ser Arg Gly Gly Leu Ser Thr Gln Glu Asn Arg  
 55 60 65

gat ctg gtg tcc ttc gtg gaa ctt aag gct cgt ttg gaa aag cgc agg 355  
 Asp Leu Val Ser Phe Val Glu Leu Lys Ala Arg Leu Glu Lys Arg Arg  
 70 75 80 85

ctt gag gat cta gat taaatctatg cgaggatttt tca 393  
 Leu Glu Asp Leu Asp  
 90

&lt;210&gt; 224

&lt;211&gt; 90

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 224

Met His Leu Leu Arg Asp Asp Asn Trp Trp Ala Pro Gly Phe Val Lys  
 1 5 10 15

Lys Ala Tyr Thr Val Met Gly His Gly Ser Glu Val Glu Glu Ala Pro  
 20 25 30

Arg Pro Thr Thr Arg Arg Leu Asn Asp Asp Glu Glu Val Thr Val His  
 35 40 45

Glu Ala Val Val Ala Gly Asp Thr Val Ala Ser Arg Gly Gly Leu Ser  
 50 55 60

Thr Gln Glu Asn Arg Asp Leu Val Ser Phe Val Glu Leu Lys Ala Arg  
 65 70 75 80

Leu Glu Lys Arg Arg Leu Glu Asp Leu Asp  
85 90

<210> 225  
<211> 2214  
<212> DNA  
<213> Corynebacterium glutamicum

<220>  
<221> CDS  
<222> (101)..(2191)  
<223> RXA02587

<400> 225  
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Val Phe Ser Lys Trp  
1 5  
ggc cac ttt gct tac aga ttt agg cgc att gtt ccg tta gtc gtc atc 163  
Gly His Phe Ala Tyr Arg Phe Arg Arg Ile Val Pro Leu Val Val Ile  
10 15 20  
gcc gcg att ttg gct ttg ttt gtc att ttc ggc acc aag ctg ggc gac 211  
Ala Ala Ile Leu Ala Leu Phe Val Ile Phe Gly Thr Lys Leu Gly Asp  
25 30 35  
cgc atg agc cag gaa gga tgg gat gat cct ggt tct tcc tcg acc gct 259  
Arg Met Ser Gln Glu Gly Trp Asp Asp Pro Gly Ser Ser Ser Thr Ala  
40 45 50  
gcg gcg cgc atc gag ttg gag acc ttt ggg cgt gac aat gac ggc gat 307  
Ala Ala Arg Ile Glu Leu Glu Thr Phe Gly Arg Asp Asn Asp Gly Asp  
55 60 65  
gtc gtg ttg ctg ttt act gcg cct gaa ggc act tct ttc gat gat gca 355  
Val Val Leu Leu Phe Thr Ala Pro Glu Gly Thr Ser Phe Asp Asp Ala  
70 75 80 85  
gag gtg ttc tcc agc atc tct ggc tac tta gat ggg cta atc gag aac 403  
Glu Val Phe Ser Ser Ile Ser Gly Tyr Leu Asp Gly Leu Ile Glu Asn  
90 95 100  
aac cct gat gaa gtc agc cac atc aac agc tac ttt gac act cgt aat 451  
Asn Pro Asp Glu Val Ser His Ile Asn Ser Tyr Phe Asp Thr Arg Asn  
105 110 115  
caa aat ctc ctc agc aaa gac ggc acc caa acc ttt gca gct ctc ggg 499  
Gln Asn Leu Leu Ser Lys Asp Gly Thr Gln Thr Phe Ala Ala Leu Gly  
120 125 130  
ctc aaa ggt gac ggc gag caa acg ctg aag gac ttc cgg gag att gaa 547  
Leu Lys Gly Asp Gly Glu Gln Thr Leu Lys Asp Phe Arg Glu Ile Glu  
135 140 145

gat cag ctc cat ccg gac aac ctt gcc ggt ggc gtc acc act gag gtc	595
Asp Gln Leu His Pro Asp Asn Leu Ala Gly Gly Val Thr Thr Glu Val	
150 155 160 165	
gcg ggt gcc acc gct gta gcc gac gca ctc gat gag ggc atg gct ggc	643
Ala Gly Ala Thr Ala Val Ala Asp Ala Leu Asp Glu Gly Met Ala Gly	
170 175 180	
gat att tca cgc gcc gaa gtt ttt gcg ctg cct ttc gtg gct atc ttg	691
Asp Ile Ser Arg Ala Glu Val Phe Ala Leu Pro Phe Val Ala Ile Leu	
185 190 195	
ctg ctc atc gtg ttt ggc tca gtt gtt gcc gcg gcg atg cca ttg atc	739
Leu Leu Ile Val Phe Gly Ser Val Val Ala Ala Ala Met Pro Leu Ile	
200 205 210	
gtg ggc att ttg tcc atc ttg ggt tcc ctg ggc atc ttg gca att ttg	787
Val Gly Ile Leu Ser Ile Leu Gly Ser Leu Gly Ile Leu Ala Ile Leu	
215 220 225	
gct gga ttc ttc cag gtc aac gta ttt gca caa tct gtt gtg acc ctt	835
Ala Gly Phe Phe Gln Val Asn Val Phe Ala Gln Ser Val Val Thr Leu	
230 235 240 245	
ctg ggc ttg ggt ctt gcc att gac tat ggc tta ttc atg gtc tct cgt	883
Leu Gly Leu Gly Leu Ala Ile Asp Tyr Gly Leu Phe Met Val Ser Arg	
250 255 260	
ttc cgt gag gaa atg gat aag ggc acc ccg gtt gaa cag gct gtt gcc	931
Phe Arg Glu Glu Met Asp Lys Gly Thr Pro Val Glu Gln Ala Val Ala	
265 270 275	
acc act acg gcg acc gcg ggt aag act gtg gtg ttc tct gca gcg atg	979
Thr Thr Thr Ala Thr Ala Gly Lys Thr Val Val Phe Ser Ala Ala Met	
280 285 290	
gtg gct gtg gcg ctg tcc ggg ttg ttt gtt ttc cca cag gct ttc ttg	1027
Val Ala Val Ala Leu Ser Gly Leu Phe Val Phe Pro Gln Ala Phe Leu	
295 300 305	
aag tcc gtg gca ttc ggt gcg att tcc gcg gtt ggc ctt gct gct ttg	1075
Lys Ser Val Ala Phe Gly Ala Ile Ser Ala Val Gly Leu Ala Ala Leu	
310 315 320 325	
atg tcc gtg acg gtg ttg ccg tcc ctg ttc agc atg ttg ggt aag aat	1123
Met Ser Val Thr Val Leu Pro Ser Leu Phe Ser Met Leu Gly Lys Asn	
330 335 340	
atc gat aag tgg agt ttg cgt cgc act gct cga aca gcg cgc cgt ttg	1171
Ile Asp Lys Trp Ser Leu Arg Arg Thr Ala Arg Thr Ala Arg Arg Leu	
345 350 355	
gaa gac acc att tgg tac cgc gtg ccg gca tgg gca atg cgc cat gcc	1219
Glu Asp Thr Ile Trp Tyr Arg Val Pro Ala Trp Ala Met Arg His Ala	
360 365 370	

aag gca gtg acc gtg ggc gtc gta ttg ctc ttg ctt gct ctt aca gtg	1267
Lys Ala Val Thr Val Gly Val Val Leu Leu Leu Leu Ala Leu Thr Val	
375 380 385	
ccg ttg acg ggc gtg aaa ttc ggc ggc atc aat gaa acg tat ctg cca	1315
Pro Leu Thr Gly Val Lys Phe Gly Gly Ile Asn Glu Thr Tyr Leu Pro	
390 395 400 405	
cca gct aac gac acc cgc gtc gcc caa gag cgt ttc gac gag gcg ttt	1363
Pro Ala Asn Asp Thr Arg Val Ala Gln Glu Arg Phe Asp Glu Ala Phe	
410 415 420	
ccc gcc ttc cgc acc gag ccg gtc aag ctt gtg gtc acc ggg gcg gac	1411
Pro Ala Phe Arg Thr Glu Pro Val Lys Leu Val Val Thr Gly Ala Asp	
425 430 435	
aac aac cag ctg atc gat atc tat gtt cag gcc aac gaa gtt gag gga	1459
Asn Asn Gln Leu Ile Asp Ile Tyr Val Gln Ala Asn Glu Val Glu Gly	
440 445 450	
ctg aca gat cgt ttc acc gca ggt gcg act acc gat gat ggc acc acg	1507
Leu Thr Asp Arg Phe Thr Ala Gly Ala Thr Thr Asp Asp Gly Thr Thr	
455 460 465	
gtg ttg tct act ggt att cag gat cgt tcc ctc aat gag cag gta gtg	1555
Val Leu Ser Thr Gly Ile Gln Asp Arg Ser Leu Asn Glu Gln Val Val	
470 475 480 485	
gag cag ctt cgc gct att tcc gtc cct gag ggc gtt gag gtg cag atc	1603
Glu Gln Leu Arg Ala Ile Ser Val Pro Glu Gly Val Glu Val Gln Ile	
490 495 500	
ggt ggc act cca gcc atg gag atc gaa tcc att gag gcg ctc ttt gaa	1651
Gly Gly Thr Pro Ala Met Glu Ile Glu Ser Ile Glu Ala Leu Phe Glu	
505 510 515	
aag ctc ctc tgg atg gct ctc tac att gtg ctg gcc act ttc atc ctc	1699
Lys Leu Leu Trp Met Ala Leu Tyr Ile Val Leu Ala Thr Phe Ile Leu	
520 525 530	
atg gca ttg gta ttt ggt tcg gtg att ttg ccg gcg aag gcc atc atc	1747
Met Ala Leu Val Phe Gly Ser Val Ile Leu Pro Ala Lys Ala Ile Ile	
535 540 545	
atg acc att ctg ggt atg ggt gcc acc ttg ggt att ctc acc ttg atg	1795
Met Thr Ile Leu Gly Met Gly Ala Thr Leu Gly Ile Leu Thr Leu Met	
550 555 560 565	
ttc gtc gat ggc gtg ggt gcc agc gca ttg aac ttc tcc cct ggc cca	1843
Phe Val Asp Gly Val Gly Ala Ser Ala Leu Asn Phe Ser Pro Gly Pro	
570 575 580	
ctg atg agt cca gtg ctg gtg ctg atc atg gct att att tac gga ctt	1891
Leu Met Ser Pro Val Leu Val Leu Ile Met Ala Ile Ile Tyr Gly Leu	
585 590 595	
tcc acc gac tat gag gtg ttc ctg gta tct cgc atg gtg gag gcc cgc	1939

Ser Thr Asp Tyr Glu Val Phe Leu Val Ser Arg Met Val Glu Ala Arg  
600 605 610

gat aaa ggc gaa tcc acc gac gac gcc atc aga tac ggc act gca cac 1987  
Asp Lys Gly Glu Ser Thr Asp Asp Ala Ile Arg Tyr Gly Thr Ala His  
615 620 625

acc gga tct atc atc acc gcg gcc gca ctg atc atg att gtg gtc tgt 2035  
Thr Gly Ser Ile Ile Thr Ala Ala Leu Ile Met Ile Val Val Cys  
630 635 640 645

gga gcg ttt ggt ttc tct gag atc gtc atg atg aag tac atc gcg ttc 2083  
Gly Ala Phe Gly Phe Ser Glu Ile Val Met Met Lys Tyr Ile Ala Phe  
650 655 660

ggc atg atc gca gcg ctg att ctg gat gcc acc atc atc cgc atg ctg 2131  
Gly Met Ile Ala Ala Leu Ile Leu Asp Ala Thr Ile Ile Arg Met Leu  
665 670 675

ctt gtc ccc cgc cgt gat gca cct gct tcg cga cga caa ctg gtg ggc 2179  
Leu Val Pro Arg Arg Asp Ala Pro Ala Ser Arg Arg Gln Leu Val Gly  
680 685 690

acc cgg ctt cgt taaaaaggcc tacaccgtca tgg 2214  
Thr Arg Leu Arg  
695

<210> 226  
<211> 697  
<212> PRT  
<213> Corynebacterium glutamicum

<400> 226  
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1 5 10 15

Pro Leu Val Val Ile Ala Ala Ile Leu Ala Leu Phe Val Ile Phe Gly  
20 25 30

Thr Lys Leu Gly Asp Arg Met Ser Gln Glu Gly Trp Asp Asp Pro Gly  
35 40 45

Ser Ser Ser Thr Ala Ala Ala Arg Ile Glu Leu Glu Thr Phe Gly Arg  
50 55 60

Asp Asn Asp Gly Asp Val Val Leu Leu Phe Thr Ala Pro Glu Gly Thr  
65 70 75 80

Ser Phe Asp Asp Ala Glu Val Phe Ser Ser Ile Ser Gly Tyr Leu Asp  
85 90 95

Gly Leu Ile Glu Asn Asn Pro Asp Glu Val Ser His Ile Asn Ser Tyr  
100 105 110

Phe Asp Thr Arg Asn Gln Asn Leu Leu Ser Lys Asp Gly Thr Gln Thr  
115 120 125



Phe Ala Ala Leu Gly Leu Lys Gly Asp Gly Glu Gln Thr Leu Lys Asp  
 130 135 140  
 Phe Arg Glu Ile Glu Asp Gln Leu His Pro Asp Asn Leu Ala Gly Gly  
 145 150 155 160  
 Val Thr Thr Glu Val Ala Gly Ala Thr Ala Val Ala Asp Ala Leu Asp  
 165 170 175  
 Glu Gly Met Ala Gly Asp Ile Ser Arg Ala Glu Val Phe Ala Leu Pro  
 180 185 190  
 Phe Val Ala Ile Leu Leu Leu Ile Val Phe Gly Ser Val Val Ala Ala  
 195 200 205  
 Ala Met Pro Leu Ile Val Gly Ile Leu Ser Ile Leu Gly Ser Leu Gly  
 210 215 220  
 Ile Leu Ala Ile Leu Ala Gly Phe Phe Gln Val Asn Val Phe Ala Gln  
 225 230 235 240  
 Ser Val Val Thr Leu Leu Gly Leu Gly Leu Ala Ile Asp Tyr Gly Leu  
 245 250 255  
 Phe Met Val Ser Arg Phe Arg Glu Glu Met Asp Lys Gly Thr Pro Val  
 260 265 270  
 Glu Gln Ala Val Ala Thr Thr Thr Ala Thr Ala Gly Lys Thr Val Val  
 275 280 285  
 Phe Ser Ala Ala Met Val Ala Val Ala Leu Ser Gly Leu Phe Val Phe  
 290 295 300  
 Pro Gln Ala Phe Leu Lys Ser Val Ala Phe Gly Ala Ile Ser Ala Val  
 305 310 315 320  
 Gly Leu Ala Ala Leu Met Ser Val Thr Val Leu Pro Ser Leu Phe Ser  
 325 330 335  
 Met Leu Gly Lys Asn Ile Asp Lys Trp Ser Leu Arg Arg Thr Ala Arg  
 340 345 350  
 Thr Ala Arg Arg Leu Glu Asp Thr Ile Trp Tyr Arg Val Pro Ala Trp  
 355 360 365  
 Ala Met Arg His Ala Lys Ala Val Thr Val Gly Val Val Leu Leu Leu  
 370 375 380  
 Leu Ala Leu Thr Val Pro Leu Thr Gly Val Lys Phe Gly Gly Ile Asn  
 385 390 395 400  
 Glu Thr Tyr Leu Pro Pro Ala Asn Asp Thr Arg Val Ala Gln Glu Arg  
 405 410 415  
 Phe Asp Glu Ala Phe Pro Ala Phe Arg Thr Glu Pro Val Lys Leu Val  
 420 425 430

Val Thr Gly Ala Asp Asn Asn Gln Leu Ile Asp Ile Tyr Val Gln Ala  
 435 440 445  
 Asn Glu Val Glu Gly Leu Thr Asp Arg Phe Thr Ala Gly Ala Thr Thr  
 450 455 460  
 Asp Asp Gly Thr Thr Val Leu Ser Thr Gly Ile Gln Asp Arg Ser Leu  
 465 470 475 480  
 Asn Glu Gln Val Val Glu Gln Leu Arg Ala Ile Ser Val Pro Glu Gly  
 485 490 495  
 Val Glu Val Gln Ile Gly Gly Thr Pro Ala Met Glu Ile Glu Ser Ile  
 500 505 510  
 Glu Ala Leu Phe Glu Lys Leu Leu Trp Met Ala Leu Tyr Ile Val Leu  
 515 520 525  
 Ala Thr Phe Ile Leu Met Ala Leu Val Phe Gly Ser Val Ile Leu Pro  
 530 535 540  
 Ala Lys Ala Ile Ile Met Thr Ile Leu Gly Met Gly Ala Thr Leu Gly  
 545 550 555 560  
 Ile Leu Thr Leu Met Phe Val Asp Gly Val Gly Ala Ser Ala Leu Asn  
 565 570 575  
 Phe Ser Pro Gly Pro Leu Met Ser Pro Val Leu Val Leu Ile Met Ala  
 580 585 590  
 Ile Ile Tyr Gly Leu Ser Thr Asp Tyr Glu Val Phe Leu Val Ser Arg  
 595 600 605  
 Met Val Glu Ala Arg Asp Lys Gly Glu Ser Thr Asp Asp Ala Ile Arg  
 610 615 620  
 Tyr Gly Thr Ala His Thr Gly Ser Ile Ile Thr Ala Ala Ala Leu Ile  
 625 630 635 640  
 Met Ile Val Val Cys Gly Ala Phe Gly Phe Ser Glu Ile Val Met Met  
 645 650 655  
 Lys Tyr Ile Ala Phe Gly Met Ile Ala Ala Leu Ile Leu Asp Ala Thr  
 660 665 670  
 Ile Ile Arg Met Leu Leu Val Pro Arg Arg Asp Ala Pro Ala Ser Arg  
 675 680 685  
 Arg Gln Leu Val Gly Thr Arg Leu Arg  
 690 695

&lt;210&gt; 227

&lt;211&gt; 729

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(706)

&lt;223&gt; RXN03042

&lt;400&gt; 227

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tcgcctcggc gacgtcctgg ttccttacgt tctgatcgtt ttg gtt cta gcg ttc 115  
 Leu Val Leu Ala Phe  
 1 5

ctc gtg ctg ttg ctc gtg ttc cgg tcc att tgg gtc cca ttg atc gcg 163  
 Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp Val Pro Leu Ile Ala  
 10 15 20

gct ctg ggc ttt ggc ttg tca gtt ctg gct acc ttt ggt gct acc gtg 211  
 Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr Phe Gly Ala Thr Val  
 25 30 35

gcg atc ttc caa gaa ggt gct ttc ggc atc atc gac gat cct cag cca 259  
 Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile Asp Asp Pro Gln Pro  
 40 45 50

ctg ctg tcc ttc ttg ccg atc atg ctc atc ggc ctg gta ttt ggt ctg 307  
 Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly Leu Val Phe Gly Leu  
 55 60 65

gcc atg gat tac cag atc ttc ctc gtt act cgt atg cgt gag ggc ttc 355  
 Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg Met Arg Glu Gly Phe  
 70 75 80 85

acc aag ggc aag act gcg ggc aac gca acg tcg aat ggt ttc aag cac 403  
 Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser Asn Gly Phe Lys His  
 90 95 100

ggt gcc cgc gtg gtc act gct gcg gcg ctg atc atg gtg tct gtg ttc 451  
 Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile Met Val Ser Val Phe  
 105 110 115

gcg gca ttc ata gcg cag gac atg gcg ttt att aag acc atg ggc ttt 499  
 Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile Lys Thr Met Gly Phe  
 120 125 130

gct ctg gcc gtt gct gtg ttc ttc gat gcc ttc gtt gtt cgc atg atg 547  
 Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe Val Val Arg Met Met  
 135 140 145

att atc cct gca aca atg ttc ctg ctt gat gac aag gct tgg tgg cta 595  
 Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp Lys Ala Trp Trp Leu  
 150 155 160 165

cct aag tgg ttg gat aag att ctt ccc aac gtt gat gtt gaa ggt gag 643  
 Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val Asp Val Glu Gly Glu  
 170 175 180

ggt ctt agt gaa cta cat gag gct cgc acc gag gaa ctg aag gaa aat 691  
 Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu Glu Leu Lys Glu Asn  
                   185                                  190                                  195

gta ggt gtc ggg gct tagagaaaca aaaaaggctg cta 729  
 Val Gly Val Gly Ala  
                   200

<210> 228

<211> 202

<212> PRT

<213> Corynebacterium glutamicum

<400> 228

Leu Val Leu Ala Phe Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp  
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Val Pro Leu Ile Ala Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr  
                   20                                  25                                  30

Phe Gly Ala Thr Val Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile  
           35                                  40                                  45

Asp Asp Pro Gln Pro Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly  
           50                                  55                                  60

Leu Val Phe Gly Leu Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg  
           65                                  70                                  75                                  80

Met Arg Glu Gly Phe Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser  
                   85                                  90                                  95

Asn Gly Phe Lys His Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile  
                   100                                  105                                  110

Met Val Ser Val Phe Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile  
           115                                  120                                  125

Lys Thr Met Gly Phe Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe  
           130                                  135                                  140

Val Val Arg Met Met Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp  
           145                                  150                                  155                                  160

Lys Ala Trp Trp Leu Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val  
                   165                                  170                                  175

Asp Val Glu Gly Glu Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu  
                   180                                  185                                  190

Glu Leu Lys Glu Asn Val Gly Val Gly Ala  
           195                                  200

<210> 229

<211> 729

&lt;212&gt; DNA

<213> *Corynebacterium glutamicum*

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(706)

&lt;223&gt; FRXA02893

&lt;400&gt; 229

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tcgcctcggc gacgtcctgg ttccttacgt tctgatcgtt ttg gtt cta gcg ttc 115
                                   Leu Val Leu Ala Phe
                                   1                               5

ctc gtg ctg ttg ctc gtg ttc cgg tcc att tgg gtc cca ttg atc gcg 163
Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp Val Pro Leu Ile Ala
              10                      15                      20

gct ctg ggc ttt ggc ttg tca gtt ctg gct acc ttt ggt gct acc gtg 211
Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr Phe Gly Ala Thr Val
              25                      30                      35

gcg atc ttc caa gaa ggt gct ttc ggc atc atc gac gat cct cag cca 259
Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile Asp Asp Pro Gln Pro
              40                      45                      50

ctg ctg tcc ttc ttg ccg atc atg ctc atc ggc ctg gta ttt ggt ctg 307
Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly Leu Val Phe Gly Leu
              55                      60                      65

gcc atg gat tac cag atc ttc ctc gtt act cgt atg cgt gag ggc ttc 355
Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg Met Arg Glu Gly Phe
              70                      75                      80                      85

acc aag ggc aag act gcg ggc aac gca acg tcg aat ggt ttc aag cac 403
Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser Asn Gly Phe Lys His
              90                      95                      100

ggt gcc cgc gtg gtc act gct gcg gcg ctg atc atg gtg tct gtg ttc 451
Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile Met Val Ser Val Phe
              105                      110                      115

gcg gca ttc ata gcg cag gac atg gcg ttt att aag acc atg ggc ttt 499
Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile Lys Thr Met Gly Phe
              120                      125                      130

gct ctg gcc gtt gct gtg ttc ttc gat gcc ttc gtt gtt cgc atg atg 547
Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe Val Val Arg Met Met
              135                      140                      145

att atc cct gca aca atg ttc ctg ctt gat gac aag gct tgg tgg cta 595
Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp Lys Ala Trp Trp Leu
              150                      155                      160                      165

cct aag tgg ttg gat aag att ctt ccc aac gtt gat gtt gaa ggt gag 643
Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val Asp Val Glu Gly Glu

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	170	175	180	
ggt ctt agt gaa cta cat gag gct cgc acc gag gaa ctg aag gaa aat				691
Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu Glu Leu Lys Glu Asn				
	185	190	195	
gta ggt gtc ggg gct tagagaaaca aaaaaggctg cta				729
Val Gly Val Gly Ala				
	200			

&lt;210&gt; 230

&lt;211&gt; 202

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 230

Leu Val Leu Ala Phe Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp				
1	5	10	15	
Val Pro Leu Ile Ala Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr				
20	25	30		
Phe Gly Ala Thr Val Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile				
35	40	45		
Asp Asp Pro Gln Pro Leu Leu Ser Phe Leu Pro Ile Met Leu Ile Gly				
50	55	60		
Leu Val Phe Gly Leu Ala Met Asp Tyr Gln Ile Phe Leu Val Thr Arg				
65	70	75	80	
Met Arg Glu Gly Phe Thr Lys Gly Lys Thr Ala Gly Asn Ala Thr Ser				
85	90	95		
Asn Gly Phe Lys His Gly Ala Arg Val Val Thr Ala Ala Ala Leu Ile				
100	105	110		
Met Val Ser Val Phe Ala Ala Phe Ile Ala Gln Asp Met Ala Phe Ile				
115	120	125		
Lys Thr Met Gly Phe Ala Leu Ala Val Ala Val Phe Phe Asp Ala Phe				
130	135	140		
Val Val Arg Met Met Ile Ile Pro Ala Thr Met Phe Leu Leu Asp Asp				
145	150	155	160	
Lys Ala Trp Trp Leu Pro Lys Trp Leu Asp Lys Ile Leu Pro Asn Val				
165	170	175		
Asp Val Glu Gly Glu Gly Leu Ser Glu Leu His Glu Ala Arg Thr Glu				
180	185	190		
Glu Leu Lys Glu Asn Val Gly Val Gly Ala				
195	200			

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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1582)  
 <223> RXA01616

<400> 231  
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 Met Thr Ser Glu Thr  
 1 5  
 tta cag gcg caa gcg cct acg aaa acc caa cgt tgg gct ttc ctc gcc 163  
 Leu Gln Ala Gln Ala Pro Thr Lys Thr Gln Arg Trp Ala Phe Leu Ala  
 10 15 20  
 gtt atc agc ggt ggt ctc ttt ctg atc ggt gta gac aac tcg att ctc 211  
 Val Ile Ser Gly Gly Leu Phe Leu Ile Gly Val Asp Asn Ser Ile Leu  
 25 30 35  
 tac acc gca ctc cct ctg ctg cgt gaa cag ctc gca gcc tcc gaa acc 259  
 Tyr Thr Ala Leu Pro Leu Leu Arg Glu Gln Leu Ala Ala Ser Glu Thr  
 40 45 50  
 caa gcg ttg tgg atc atc aac gca tat ccc ctg ctc atg gcg ggc ctt 307  
 Gln Ala Leu Trp Ile Ile Asn Ala Tyr Pro Leu Leu Met Ala Gly Leu  
 55 60 65  
 cgt ttg ggt gcc ggc act ttg ggt gac aaa aac ggc cac cgc cgg atg 355  
 Arg Leu Gly Ala Gly Thr Leu Gly Asp Lys Asn Gly His Arg Arg Met  
 70 75 80 85  
 ttc ctc atg ggc ttg agc att ttc gga atc gct tca ctt ggt gct gcg 403  
 Phe Leu Met Gly Leu Ser Ile Phe Gly Ile Ala Ser Leu Gly Ala Ala  
 90 95 100  
 ttt gct cca act gcg tgg gct ctt gtt gct gcg aga gct ttc ctt ggc 451  
 Phe Ala Pro Thr Ala Trp Ala Leu Val Ala Ala Arg Ala Phe Leu Gly  
 105 110 115  
 atc ggt gcg gca acg atg atg cct gca acc ttg gct ctg atc cgc att 499  
 Ile Gly Ala Ala Thr Met Met Pro Ala Thr Leu Ala Leu Ile Arg Ile  
 120 125 130  
 acg ttt gag gat gag cgt gag cgc aac act gca att ggt att tgg ggt 547  
 Thr Phe Glu Asp Glu Arg Glu Arg Asn Thr Ala Ile Gly Ile Trp Gly  
 135 140 145  
 tcc gtg gca att ctt ggc gct gcg gca ggc ccg atc att ggt ggt gcg 595  
 Ser Val Ala Ile Leu Gly Ala Ala Ala Gly Pro Ile Ile Gly Gly Ala  
 150 155 160 165



ctg ttg gaa ttc ttc tgg tgg ggt tcg gtt ttc ctc att aac gtt ccg	643
Leu Leu Glu Phe Phe Trp Trp Gly Ser Val Phe Leu Ile Asn Val Pro	
170 175 180	
gtg gct gtt atc gcg ttg atc gct acg ctt ttt gtg gcg ccg gcc aat	691
Val Ala Val Ile Ala Leu Ile Ala Thr Leu Phe Val Ala Pro Ala Asn	
185 190 195	
atc gcg aat ccg tct aag cat tgg gat ttc ttg tcg tcg ttc tat gcg	739
Ile Ala Asn Pro Ser Lys His Trp Asp Phe Leu Ser Ser Phe Tyr Ala	
200 205 210	
ctg ctc aca ctt gct ggg ttg atc atc acg atc aag gaa tct gtg aat	787
Leu Leu Thr Leu Ala Gly Leu Ile Ile Thr Ile Lys Glu Ser Val Asn	
215 220 225	
act gca cgc cat atg cct ctt ctt ttg ggt gca gtc atc atg ttg atc	835
Thr Ala Arg His Met Pro Leu Leu Leu Gly Ala Val Ile Met Leu Ile	
230 235 240 245	
att ggt gcg gtg ttg ttt agc agt cgt cag aag aag atc gag gag cca	883
Ile Gly Ala Val Leu Phe Ser Ser Arg Gln Lys Lys Ile Glu Glu Pro	
250 255 260	
ctt cta gat ctg tcg ttg ttc cgt aat cgc ctt ttc tta ggc ggt gtg	931
Leu Leu Asp Leu Ser Leu Phe Arg Asn Arg Leu Phe Leu Gly Gly Val	
265 270 275	
gtt gct gcg ggc atg gcg atg ttt act gtg tcc ggt ttg gaa atg act	979
Val Ala Ala Gly Met Ala Met Phe Thr Val Ser Gly Leu Glu Met Thr	
280 285 290	
acc tcg cag cgt ttc cag ttg tct gtg ggt ttc act cca ctt gag gct	1027
Thr Ser Gln Arg Phe Gln Leu Ser Val Gly Phe Thr Pro Leu Glu Ala	
295 300 305	
ggt ttg ctc atg atc cca gct gca ttg ggt agc ttc ccg atg tct att	1075
Gly Leu Leu Met Ile Pro Ala Ala Leu Gly Ser Phe Pro Met Ser Ile	
310 315 320 325	
atc ggt ggt gca aac ctg cat cgt tgg ggc ttc aaa ccg ctg atc agt	1123
Ile Gly Gly Ala Asn Leu His Arg Trp Gly Phe Lys Pro Leu Ile Ser	
330 335 340	
ggt ggt ttt gct gcc act gcc gtt ggc atc gcc ctg tgt att tgg ggc	1171
Gly Gly Phe Ala Ala Thr Ala Val Gly Ile Ala Leu Cys Ile Trp Gly	
345 350 355	
gcg act cat act gat ggt ttg ccg ttt ttc atc gcg ggt cta ttc ttc	1219
Ala Thr His Thr Asp Gly Leu Pro Phe Phe Ile Ala Gly Leu Phe Phe	
360 365 370	
atg ggc gcg ggt gct ggt tcg gta atg tct gtg tct tcc act gcg att	1267
Met Gly Ala Gly Ala Gly Ser Val Met Ser Val Ser Ser Thr Ala Ile	
375 380 385	
atc ggt tcc gcg ccg gtg cgt aag gct ggc atg gcg tcg tcg atc gaa	1315

Ile Gly Ser Ala Pro Val Arg Lys Ala Gly Met Ala Ser Ser Ile Glu  
 390 395 400 405

gag gtc tct tat gag ttc ggc acg ctg ttg tct gtc gcg att ttg ggt 1363  
 Glu Val Ser Tyr Glu Phe Gly Thr Leu Leu Ser Val Ala Ile Leu Gly  
 410 415 420

agc ttg ttc cca ttc ttc tac tcg ctg cat gcc ccg gca gag gtt gcg 1411  
 Ser Leu Phe Pro Phe Phe Tyr Ser Leu His Ala Pro Ala Glu Val Ala  
 425 430 435

gat aac ttc tcg gcg ggt gtt cac cac gcg att gat ggc gat gcg gcg 1459  
 Asp Asn Phe Ser Ala Gly Val His His Ala Ile Asp Gly Asp Ala Ala  
 440 445 450

cgt gca tct ttg gac acc gca tac att aac gtg ttg atc att gcc cta 1507  
 Arg Ala Ser Leu Asp Thr Ala Tyr Ile Asn Val Leu Ile Ile Ala Leu  
 455 460 465

gta tgc gca gta gcg gct gct ctg atc agc agt tac ctt ttc cgc gga 1555  
 Val Cys Ala Val Ala Ala Ala Leu Ile Ser Ser Tyr Leu Phe Arg Gly  
 470 475 480 485

aat ccg aag gga gcc aat aat gcg cac tagtaaaaaa gagatgattc 1602  
 Asn Pro Lys Gly Ala Asn Asn Ala His  
 490

tgc 1605

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 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 232  
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Asp Asn Ser Ile Leu Tyr Thr Ala Leu Pro Leu Leu Arg Glu Gln Leu  
 35 40 45

Ala Ala Ser Glu Thr Gln Ala Leu Trp Ile Ile Asn Ala Tyr Pro Leu  
 50 55 60

Leu Met Ala Gly Leu Arg Leu Gly Ala Gly Thr Leu Gly Asp Lys Asn  
 65 70 75 80

Gly His Arg Arg Met Phe Leu Met Gly Leu Ser Ile Phe Gly Ile Ala  
 85 90 95

Ser Leu Gly Ala Ala Phe Ala Pro Thr Ala Trp Ala Leu Val Ala Ala  
 100 105 110

Arg Ala Phe Leu Gly Ile Gly Ala Ala Thr Met Met Pro Ala Thr Leu  
 115 120 125  
 Ala Leu Ile Arg Ile Thr Phe Glu Asp Glu Arg Glu Arg Asn Thr Ala  
 130 135 140  
 Ile Gly Ile Trp Gly Ser Val Ala Ile Leu Gly Ala Ala Ala Gly Pro  
 145 150 155 160  
 Ile Ile Gly Gly Ala Leu Leu Glu Phe Phe Trp Trp Gly Ser Val Phe  
 165 170 175  
 Leu Ile Asn Val Pro Val Ala Val Ile Ala Leu Ile Ala Thr Leu Phe  
 180 185 190  
 Val Ala Pro Ala Asn Ile Ala Asn Pro Ser Lys His Trp Asp Phe Leu  
 195 200 205  
 Ser Ser Phe Tyr Ala Leu Leu Thr Leu Ala Gly Leu Ile Ile Thr Ile  
 210 215 220  
 Lys Glu Ser Val Asn Thr Ala Arg His Met Pro Leu Leu Leu Gly Ala  
 225 230 235 240  
 Val Ile Met Leu Ile Ile Gly Ala Val Leu Phe Ser Ser Arg Gln Lys  
 245 250 255  
 Lys Ile Glu Glu Pro Leu Leu Asp Leu Ser Leu Phe Arg Asn Arg Leu  
 260 265 270  
 Phe Leu Gly Gly Val Val Ala Ala Gly Met Ala Met Phe Thr Val Ser  
 275 280 285  
 Gly Leu Glu Met Thr Thr Ser Gln Arg Phe Gln Leu Ser Val Gly Phe  
 290 295 300  
 Thr Pro Leu Glu Ala Gly Leu Leu Met Ile Pro Ala Ala Leu Gly Ser  
 305 310 315 320  
 Phe Pro Met Ser Ile Ile Gly Gly Ala Asn Leu His Arg Trp Gly Phe  
 325 330 335  
 Lys Pro Leu Ile Ser Gly Gly Phe Ala Ala Thr Ala Val Gly Ile Ala  
 340 345 350  
 Leu Cys Ile Trp Gly Ala Thr His Thr Asp Gly Leu Pro Phe Phe Ile  
 355 360 365  
 Ala Gly Leu Phe Phe Met Gly Ala Gly Ala Gly Ser Val Met Ser Val  
 370 375 380  
 Ser Ser Thr Ala Ile Ile Gly Ser Ala Pro Val Arg Lys Ala Gly Met  
 385 390 395 400  
 Ala Ser Ser Ile Glu Glu Val Ser Tyr Glu Phe Gly Thr Leu Leu Ser  
 405 410 415

Val Ala Ile Leu Gly Ser Leu Phe Pro Phe Phe Tyr Ser Leu His Ala  
 420 425 430

Pro Ala Glu Val Ala Asp Asn Phe Ser Ala Gly Val His His Ala Ile  
 435 440 445

Asp Gly Asp Ala Ala Arg Ala Ser Leu Asp Thr Ala Tyr Ile Asn Val  
 450 455 460

Leu Ile Ile Ala Leu Val Cys Ala Val Ala Ala Ala Leu Ile Ser Ser  
 465 470 475 480

Tyr Leu Phe Arg Gly Asn Pro Lys Gly Ala Asn Asn Ala His  
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 <213> Corynebacterium glutamicum

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 <222> (101)..(1477)  
 <223> RXA01666

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 Val Ser Thr Phe His  
 1 5

aaa gtt ttg atc aac acc atg atc tcc aac gtc acc act gga ttt ctg 163  
 Lys Val Leu Ile Asn Thr Met Ile Ser Asn Val Thr Thr Gly Phe Leu  
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ttc ttt gcc gtg gtg ttt tgg atg tat ctt tcc act ggc aac gtc gca 211  
 Phe Phe Ala Val Val Phe Trp Met Tyr Leu Ser Thr Gly Asn Val Ala  
 25 30 35

ctg acc ggc atc gtc agt gga att tac atg ggt ttg atc gcc gtt tgt 259  
 Leu Thr Gly Ile Val Ser Gly Ile Tyr Met Gly Leu Ile Ala Val Cys  
 40 45 50

tcc atc ttt ttc gga acc gtt gtt gat cac aat cgc aag aag tcc gtc 307  
 Ser Ile Phe Phe Gly Thr Val Val Asp His Asn Arg Lys Lys Ser Val  
 55 60 65

atg ctg ttt tcc agc gtc acc aca ctc gtg ttt tat tgt ctc agt gcc 355  
 Met Leu Phe Ser Ser Val Thr Thr Leu Val Phe Tyr Cys Leu Ser Ala  
 70 75 80 85

ctg gtg tgg gtg ttt tgg ctg gag gaa gac ggc ctg agc atc gga aat 403  
 Leu Val Trp Val Phe Trp Leu Glu Glu Asp Gly Leu Ser Ile Gly Asn  
 90 95 100

acc gcc ctg tgg gtg ttc gtt tct ttc atc ctc atc gga tca atc gtg	451
Thr Ala Leu Trp Val Phe Val Ser Phe Ile Leu Ile Gly Ser Ile Val	
105 110 115	
gaa cac atg cgc aac atc gca ctg tcc acc gtg gtc acg ctg ttg gtt	499
Glu His Met Arg Asn Ile Ala Leu Ser Thr Val Val Thr Leu Leu Val	
120 125 130	
cct gaa gct gaa cgc gac aaa gca aac ggc ctg gta gga gcc gtg caa	547
Pro Glu Ala Glu Arg Asp Lys Ala Asn Gly Leu Val Gly Ala Val Gln	
135 140 145	
ggt gtt gga ttt tta gtc acc agc gtc att gct ggt tcc gcc atc ggg	595
Gly Val Gly Phe Leu Val Thr Ser Val Ile Ala Gly Ser Ala Ile Gly	
150 155 160 165	
ttc ttg ggc atg gaa atc acc ctg tgg atc tgc ctt ggg ctc tca ctt	643
Phe Leu Gly Met Glu Ile Thr Leu Trp Ile Cys Leu Gly Leu Ser Leu	
170 175 180	
gtc gcg ctg ctg cac ctg ctg ccg att cgc gtc gac gaa ccg gaa atc	691
Val Ala Leu Leu His Leu Leu Pro Ile Arg Val Asp Glu Pro Glu Ile	
185 190 195	
atc acc caa gaa gac gca cag cct act gtt tct gac gat tca gtt ccc	739
Ile Thr Gln Glu Asp Ala Gln Pro Thr Val Ser Asp Asp Ser Val Pro	
200 205 210	
aca cct acc tcc gat ttg gcg atc gtg tcc aaa ggc atc gac cta aaa	787
Thr Pro Thr Ser Asp Leu Ala Ile Val Ser Lys Gly Ile Asp Leu Lys	
215 220 225	
gga tca atg aaa atc atc ctg agt gtt ccg gga ctg ctc gcg ctt gtg	835
Gly Ser Met Lys Ile Ile Leu Ser Val Pro Gly Leu Leu Ala Leu Val	
230 235 240 245	
ttg ttt gcg tcc ttc aac aac ctc atc ggc ggc gtg tac tcc gca ctc	883
Leu Phe Ala Ser Phe Asn Asn Leu Ile Gly Gly Val Tyr Ser Ala Leu	
250 255 260	
atg gac cct tac ggc ctg gaa ctt ttc agc cca cag ctg tgg ggg cta	931
Met Asp Pro Tyr Gly Leu Glu Leu Phe Ser Pro Gln Leu Trp Gly Leu	
265 270 275	
ctg ctt gga ctc acc agc ctc ggc ttc atc gtt ggt ggt gct gtg atc	979
Leu Leu Gly Leu Thr Ser Leu Gly Phe Ile Val Gly Gly Ala Val Ile	
280 285 290	
tcc aaa act ggc ttg ggc aaa aac cct gtg cgc acc ttg ctg ctg gtt	1027
Ser Lys Thr Gly Leu Gly Lys Asn Pro Val Arg Thr Leu Leu Leu Val	
295 300 305	
aat gtt ggt gtg gct ttt gtt ggc atg tta ttt gcc att cgc gaa tgg	1075
Asn Val Gly Val Ala Phe Val Gly Met Leu Phe Ala Ile Arg Glu Trp	
310 315 320 325	
tgg tgg ctc tac atc ctg ggc att ttc atc ttc atg gct atc acc cca	1123

Trp Trp Leu Tyr Ile Leu Gly Ile Phe Ile Phe Met Ala Ile Thr Pro  
 330 335 340  
 gct gcc gaa gcc gca gaa caa acc atc ctt caa cga gtc gtc cca ttc 1171  
 Ala Ala Glu Ala Ala Glu Gln Thr Ile Leu Gln Arg Val Val Pro Phe  
 345 350 355  
 cgc caa caa ggc cgc gta ttt gga cta gcc atg gca gtg gaa atg gca 1219  
 Arg Gln Gln Gly Arg Val Phe Gly Leu Ala Met Ala Val Glu Met Ala  
 360 365 370  
 gcc aac ccg ctc tcc aca gtg atc gtg gcg att ttg gcc gaa gcc tac 1267  
 Ala Asn Pro Leu Ser Thr Val Ile Val Ala Ile Leu Ala Glu Ala Tyr  
 375 380 385  
 ctc att cca tgg atg gct ggc ccc ggc gcg gac acc atc tgg ggc gtg 1315  
 Leu Ile Pro Trp Met Ala Gly Pro Gly Ala Asp Thr Ile Trp Gly Val  
 390 395 400 405  
 atc ctc ggc gag ggt aaa gct cgc ggc atg gca ctg atg ttc ctc gca 1363  
 Ile Leu Gly Glu Gly Lys Ala Arg Gly Met Ala Leu Met Phe Leu Ala  
 410 415 420  
 tca ggt gcc atc atg ttg gtt gtc gtg ctg ttg gca ttc atg tcg agg 1411  
 Ser Gly Ala Ile Met Leu Val Val Val Leu Leu Ala Phe Met Ser Arg  
 425 430 435  
 tcc tac cgg aaa ctc agc cag tac tac gcc acc acc agc caa gac att 1459  
 Ser Tyr Arg Lys Leu Ser Gln Tyr Tyr Ala Thr Thr Ser Gln Asp Ile  
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 Ala Gly Ala Ala Glu Lys  
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 <213> Corynebacterium glutamicum

<400> 234  
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 Thr Gly Asn Val Ala Leu Thr Gly Ile Val Ser Gly Ile Tyr Met Gly  
 35 40 45  
 Leu Ile Ala Val Cys Ser Ile Phe Phe Gly Thr Val Val Asp His Asn  
 50 55 60  
 Arg Lys Lys Ser Val Met Leu Phe Ser Ser Val Thr Thr Leu Val Phe  
 65 70 75 80

Tyr Cys Leu Ser Ala Leu Val Trp Val Phe Trp Leu Glu Glu Asp Gly  
                     85                    90                    95  
 Leu Ser Ile Gly Asn Thr Ala Leu Trp Val Phe Val Ser Phe Ile Leu  
                     100                    105                    110  
 Ile Gly Ser Ile Val Glu His Met Arg Asn Ile Ala Leu Ser Thr Val  
                     115                    120                    125  
 Val Thr Leu Leu Val Pro Glu Ala Glu Arg Asp Lys Ala Asn Gly Leu  
                     130                    135                    140  
 Val Gly Ala Val Gln Gly Val Gly Phe Leu Val Thr Ser Val Ile Ala  
                     145                    150                    155                    160  
 Gly Ser Ala Ile Gly Phe Leu Gly Met Glu Ile Thr Leu Trp Ile Cys  
                     165                    170                    175  
 Leu Gly Leu Ser Leu Val Ala Leu Leu His Leu Leu Pro Ile Arg Val  
                     180                    185                    190  
 Asp Glu Pro Glu Ile Ile Thr Gln Glu Asp Ala Gln Pro Thr Val Ser  
                     195                    200                    205  
 Asp Asp Ser Val Pro Thr Pro Thr Ser Asp Leu Ala Ile Val Ser Lys  
                     210                    215                    220  
 Gly Ile Asp Leu Lys Gly Ser Met Lys Ile Ile Leu Ser Val Pro Gly  
                     225                    230                    235                    240  
 Leu Leu Ala Leu Val Leu Phe Ala Ser Phe Asn Asn Leu Ile Gly Gly  
                     245                    250                    255  
 Val Tyr Ser Ala Leu Met Asp Pro Tyr Gly Leu Glu Leu Phe Ser Pro  
                     260                    265                    270  
 Gln Leu Trp Gly Leu Leu Leu Gly Leu Thr Ser Leu Gly Phe Ile Val  
                     275                    280                    285  
 Gly Gly Ala Val Ile Ser Lys Thr Gly Leu Gly Lys Asn Pro Val Arg  
                     290                    295                    300  
 Thr Leu Leu Leu Val Asn Val Gly Val Ala Phe Val Gly Met Leu Phe  
                     305                    310                    315                    320  
 Ala Ile Arg Glu Trp Trp Trp Leu Tyr Ile Leu Gly Ile Phe Ile Phe  
                     325                    330                    335  
 Met Ala Ile Thr Pro Ala Ala Glu Ala Ala Glu Gln Thr Ile Leu Gln  
                     340                    345                    350  
 Arg Val Val Pro Phe Arg Gln Gln Gly Arg Val Phe Gly Leu Ala Met  
                     355                    360                    365  
 Ala Val Glu Met Ala Ala Asn Pro Leu Ser Thr Val Ile Val Ala Ile  
                     370                    375                    380



Leu Ala Glu Ala Tyr Leu Ile Pro Trp Met Ala Gly Pro Gly Ala Asp  
385 390 395 400

Thr Ile Trp Gly Val Ile Leu Gly Glu Gly Lys Ala Arg Gly Met Ala  
405 410 415

Leu Met Phe Leu Ala Ser Gly Ala Ile Met Leu Val Val Val Leu Leu  
420 425 430

Ala Phe Met Ser Arg Ser Tyr Arg Lys Leu Ser Gln Tyr Tyr Ala Thr  
435 440 445

Thr Ser Gln Asp Ile Ala Gly Ala Ala Glu Lys  
450 455

<210> 235

<211> 1521

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1498)

<223> RXA00062

<400> 235

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Met Ile Leu Ser Ile  
1 5

gtc ctt ttg ggc tac ttc atg att ctg ctt gac acc tcc atc gtc att 163  
Val Leu Leu Gly Tyr Phe Met Ile Leu Leu Asp Thr Ser Ile Val Ile  
10 15 20

acg ggt cta cct gcc atc ggc agt gaa ctt ggc atc gat ccc gtg cac 211  
Thr Gly Leu Pro Ala Ile Gly Ser Glu Leu Gly Ile Asp Pro Val His  
25 30 35

ctg tca tgg gtg cag agt tcc tac aca tta gtc ttc ggc gca ctt ctt 259  
Leu Ser Trp Val Gln Ser Ser Tyr Thr Leu Val Phe Gly Ala Leu Leu  
40 45 50

ctg ctg gga gct cgt gcc ggt gat atc ttc ggc cga aag aaa gtg ctc 307  
Leu Leu Gly Ala Arg Ala Gly Asp Ile Phe Gly Arg Lys Lys Val Leu  
55 60 65

tac att ggt ctc gcg ttg ttt gcg gct tca tcg ttg gca att gcg ctt 355  
Tyr Ile Gly Leu Ala Leu Phe Ala Ala Ser Ser Leu Ala Ile Ala Leu  
70 75 80 85

tct cca aat gct gcg gtc ctc att gga gca cgc gta gtt caa ggc gcg 403  
Ser Pro Asn Ala Ala Val Leu Ile Gly Ala Arg Val Val Gln Gly Ala  
90 95 100

gga gct gcg att atc gct cca gcg aca ctt gcg ttg att act gag ttc	451
Gly Ala Ala Ile Ile Ala Pro Ala Thr Leu Ala Leu Ile Thr Glu Phe	
105 110 115	
ttc ccc gaa ggc cca gct cgc ctt cgt gct acc tct gct tat ggt gct	499
Phe Pro Glu Gly Pro Ala Arg Leu Arg Ala Thr Ser Ala Tyr Gly Ala	
120 125 130	
gtt gcc ggc atc ggt gtg gca gca ggc cta gtg atc ggc ggc gta ttt	547
Val Ala Gly Ile Gly Val Ala Ala Gly Leu Val Ile Gly Gly Val Phe	
135 140 145	
gct gat ctt ttg tcg tgg cgc atc ggc ttc ttt atc aac gtc ccc atc	595
Ala Asp Leu Leu Ser Trp Arg Ile Gly Phe Phe Ile Asn Val Pro Ile	
150 155 160 165	
gcc gca gtg ttg gcc tac ata gtg cac aaa gcc att ccc gca acc ttc	643
Ala Ala Val Leu Ala Tyr Ile Val His Lys Ala Ile Pro Ala Thr Phe	
170 175 180	
agc agg cct gga tca ctc gac atc ttc gga gca att acc tcc acg gca	691
Ser Arg Pro Gly Ser Leu Asp Ile Phe Gly Ala Ile Thr Ser Thr Ala	
185 190 195	
ggt atc gcc gcg gtg ctc tac gca att gtc cgc agc gcc gat tac agc	739
Gly Ile Ala Ala Val Leu Tyr Ala Ile Val Arg Ser Ala Asp Tyr Ser	
200 205 210	
tgg aca gat ccg ttt gtg ttg att tcc ctc gtg ctg ggc atc gca gtg	787
Trp Thr Asp Pro Phe Val Leu Ile Ser Leu Val Leu Gly Ile Ala Val	
215 220 225	
ttc atc tgg ttc ctg cgc cat gaa tcc tca gcc aaa gaa cca ctt ctg	835
Phe Ile Trp Phe Leu Arg His Glu Ser Ser Ala Lys Glu Pro Leu Leu	
230 235 240 245	
ccc ctg ggg ctc ttt aaa aac cgc agg cga aac acc atc ttg gcc agc	883
Pro Leu Gly Leu Phe Lys Asn Arg Arg Arg Asn Thr Ile Leu Ala Ser	
250 255 260	
cgc ttt ctt ctg gtt ggc tcc gtg atg tca ttc ttc ttc ttt gcc acc	931
Arg Phe Leu Leu Val Gly Ser Val Met Ser Phe Phe Phe Phe Ala Thr	
265 270 275	
cag ctg ttc cag gac acc atg gga atg aat gct ctc cag gca ggc ctt	979
Gln Leu Phe Gln Asp Thr Met Gly Met Asn Ala Leu Gln Ala Gly Leu	
280 285 290	
gcg ttc atg ccg cta tct ctg ctg cag ttt gcc agc gcc gcg atg gtg	1027
Ala Phe Met Pro Leu Ser Leu Leu Gln Phe Ala Ser Ala Ala Met Val	
295 300 305	
cca cgg ctt tcc cga gca ggc gta tct gat tcc atg ctc acc gtc atc	1075
Pro Arg Leu Ser Arg Ala Gly Val Ser Asp Ser Met Leu Thr Val Ile	
310 315 320 325	
ggt ttc gcc atc atg gtc atc ggc atg gca ggc ctc gca ttt gta cca	1123

Gly Phe Ala Ile Met Val Ile Gly Met Ala Gly Leu Ala Phe Val Pro  
 330 335 340

aac acg atg atc gcg ctg atc cta cca ata gtt ttg gtg gga ttt ggc 1171  
 Asn Thr Met Ile Ala Leu Ile Leu Pro Ile Val Leu Val Gly Phe Gly  
 345 350 355

caa ggc ttc gct ttc gga cca atg aca gct ctg gca gtt caa ggt gca 1219  
 Gln Gly Phe Ala Phe Gly Pro Met Thr Ala Leu Ala Val Gln Gly Ala  
 360 365 370

ccg aag gac caa tcc ggc gcc gtt tct ggc ctg gtg aat tcc ctt cac 1267  
 Pro Lys Asp Gln Ser Gly Ala Val Ser Gly Leu Val Asn Ser Leu His  
 375 380 385

caa atc ggc ggc acc ttc ggt ttg ggt gtg ttc tcc tcc ttg gct gtc 1315  
 Gln Ile Gly Gly Thr Phe Gly Leu Gly Val Phe Ser Ser Leu Ala Val  
 390 395 400 405

gct gtc atc gga cat gat gca aca tca gag atg atc agc gac cgc gca 1363  
 Ala Val Ile Gly His Asp Ala Thr Ser Glu Met Ile Ser Asp Arg Ala  
 410 415 420

cac ttc gga ttc ttg ctc tcc acc gtg acg ctg acg ctg gcc acc atc 1411  
 His Phe Gly Phe Leu Leu Ser Thr Val Thr Leu Thr Leu Ala Thr Ile  
 425 430 435

ttt gcg gtc aca ctg ctg aag cgc cac gaa acc cga aag agt agc gag 1459  
 Phe Ala Val Thr Leu Leu Lys Arg His Glu Thr Arg Lys Ser Ser Glu  
 440 445 450

cgc cca acc cag ctc gtc gac gaa aag gca gtt acc tct tagtgcgctg 1508  
 Arg Pro Thr Gln Leu Val Asp Glu Lys Ala Val Thr Ser  
 455 460 465

cagcatccca gtt 1521

<210> 236  
 <211> 466  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 236  
 Met Ile Leu Ser Ile Val Leu Leu Gly Tyr Phe Met Ile Leu Leu Asp  
 1 5 10 15

Thr Ser Ile Val Ile Thr Gly Leu Pro Ala Ile Gly Ser Glu Leu Gly  
 20 25 30

Ile Asp Pro Val His Leu Ser Trp Val Gln Ser Ser Tyr Thr Leu Val  
 35 40 45

Phe Gly Ala Leu Leu Leu Leu Gly Ala Arg Ala Gly Asp Ile Phe Gly  
 50 55 60

Arg Lys Lys Val Leu Tyr Ile Gly Leu Ala Leu Phe Ala Ala Ser Ser

65	70	75	80
Leu Ala Ile Ala Leu Ser Pro Asn Ala Ala Val Leu Ile Gly Ala Arg	85	90	95
Val Val Gln Gly Ala Gly Ala Ala Ile Ile Ala Pro Ala Thr Leu Ala	100	105	110
Leu Ile Thr Glu Phe Phe Pro Glu Gly Pro Ala Arg Leu Arg Ala Thr	115	120	125
Ser Ala Tyr Gly Ala Val Ala Gly Ile Gly Val Ala Ala Gly Leu Val	130	135	140
Ile Gly Gly Val Phe Ala Asp Leu Leu Ser Trp Arg Ile Gly Phe Phe	145	150	155
Ile Asn Val Pro Ile Ala Ala Val Leu Ala Tyr Ile Val His Lys Ala	165	170	175
Ile Pro Ala Thr Phe Ser Arg Pro Gly Ser Leu Asp Ile Phe Gly Ala	180	185	190
Ile Thr Ser Thr Ala Gly Ile Ala Ala Val Leu Tyr Ala Ile Val Arg	195	200	205
Ser Ala Asp Tyr Ser Trp Thr Asp Pro Phe Val Leu Ile Ser Leu Val	210	215	220
Leu Gly Ile Ala Val Phe Ile Trp Phe Leu Arg His Glu Ser Ser Ala	225	230	235
Lys Glu Pro Leu Leu Pro Leu Gly Leu Phe Lys Asn Arg Arg Arg Asn	245	250	255
Thr Ile Leu Ala Ser Arg Phe Leu Leu Val Gly Ser Val Met Ser Phe	260	265	270
Phe Phe Phe Ala Thr Gln Leu Phe Gln Asp Thr Met Gly Met Asn Ala	275	280	285
Leu Gln Ala Gly Leu Ala Phe Met Pro Leu Ser Leu Leu Gln Phe Ala	290	295	300
Ser Ala Ala Met Val Pro Arg Leu Ser Arg Ala Gly Val Ser Asp Ser	305	310	315
Met Leu Thr Val Ile Gly Phe Ala Ile Met Val Ile Gly Met Ala Gly	325	330	335
Leu Ala Phe Val Pro Asn Thr Met Ile Ala Leu Ile Leu Pro Ile Val	340	345	350
Leu Val Gly Phe Gly Gln Gly Phe Ala Phe Gly Pro Met Thr Ala Leu	355	360	365
Ala Val Gln Gly Ala Pro Lys Asp Gln Ser Gly Ala Val Ser Gly Leu			

370

375

380

Val Asn Ser Leu His Gln Ile Gly Gly Thr Phe Gly Leu Gly Val Phe  
 385 390 395 400

Ser Ser Leu Ala Val Ala Val Ile Gly His Asp Ala Thr Ser Glu Met  
 405 410 415

Ile Ser Asp Arg Ala His Phe Gly Phe Leu Leu Ser Thr Val Thr Leu  
 420 425 430

Thr Leu Ala Thr Ile Phe Ala Val Thr Leu Leu Lys Arg His Glu Thr  
 435 440 445

Arg Lys Ser Ser Glu Arg Pro Thr Gln Leu Val Asp Glu Lys Ala Val  
 450 455 460

Thr Ser  
 465

&lt;210&gt; 237

&lt;211&gt; 1584

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(1561)

&lt;223&gt; RXA00215

&lt;400&gt; 237

cagtgcacaaac tgaccccgca tcctaaaccg cgccagattt ctacctcaaa gaattgaagg 60

ccttttccag gcgcccctcgt gcgtgaaaga ataactcaac gtg tct gac aaa aag 115  
 Val Ser Asp Lys Lys  
 1 5

cag gat cta aca tcc tcc gca gca ggt agt gct gca ccc caa acc aag 163  
 Gln Asp Leu Thr Ser Ser Ala Ala Gly Ser Ala Ala Pro Gln Thr Lys  
 10 15 20

gcc tac ccc gcc atg ccc ttg cct gaa aag caa gct tgg cca gct cta 211  
 Ala Tyr Pro Ala Met Pro Leu Pro Glu Lys Gln Ala Trp Pro Ala Leu  
 25 30 35

att gcc ttg tgc att ggg ttt ttc atg atc ctg ttg gat caa acc atc 259  
 Ile Ala Leu Cys Ile Gly Phe Phe Met Ile Leu Leu Asp Gln Thr Ile  
 40 45 50

gtg gcc gtc tct acc cca gcg tta cag gca gac atg ggc gcg tcc tac 307  
 Val Ala Val Ser Thr Pro Ala Leu Gln Ala Asp Met Gly Ala Ser Tyr  
 55 60 65

aac gag gtc atc tgg gta acc tcg gtg tat ctc ctc act ttc gcg gtg 355  
 Asn Glu Val Ile Trp Val Thr Ser Val Tyr Leu Leu Thr Phe Ala Val  
 70 75 80 85

cca ctg ctt gtt act ggc cgt ttg ggc gac aag tac ggt ccg aaa aat	403
Pro Leu Leu Val Thr Gly Arg Leu Gly Asp Lys Tyr Gly Pro Lys Asn	
90 95 100	
gtc tat gtc gca ggc atg gtt atc ttc aca gtg agc tct ttg gcc tgt	451
Val Tyr Val Ala Gly Met Val Ile Phe Thr Val Ser Ser Leu Ala Cys	
105 110 115	
ggc ttg gcc cca gac atg ttc acg ttg att atc gct cgt ggc gtt caa	499
Gly Leu Ala Pro Asp Met Phe Thr Leu Ile Ile Ala Arg Gly Val Gln	
120 125 130	
ggc ttg ggc gca gcc ctt ttg act cca caa acc atg gca aca atc aac	547
Gly Leu Gly Ala Ala Leu Leu Thr Pro Gln Thr Met Ala Thr Ile Asn	
135 140 145	
cgc atc ttt gct ttt gag cgc cgc ggt gca gct ctt gga gtg tgg ggt	595
Arg Ile Phe Ala Phe Glu Arg Arg Gly Ala Ala Leu Gly Val Trp Gly	
150 155 160 165	
tct aca gct ggc ctt gca tcc cta gca gga ccg atc ctg ggt ggt gtc	643
Ser Thr Ala Gly Leu Ala Ser Leu Ala Gly Pro Ile Leu Gly Gly Val	
170 175 180	
atc acc gaa aac tgg ggt tgg caa tgg gtc ttc tac atc aac gtg ccc	691
Ile Thr Glu Asn Trp Gly Trp Gln Trp Val Phe Tyr Ile Asn Val Pro	
185 190 195	
atc ggc gtg atc tcg gtg atc gca gta atg aag tac gtt cct gaa ttc	739
Ile Gly Val Ile Ser Val Ile Ala Val Met Lys Tyr Val Pro Glu Phe	
200 205 210	
cca ccg ctg acc cga ccg ctt gat ccg ctt tct atc gtg ttg tcc atc	787
Pro Pro Leu Thr Arg Pro Leu Asp Pro Leu Ser Ile Val Leu Ser Ile	
215 220 225	
gtg gcc gtg ttc ttc ctg gtg ttt gct ttc cag gaa ggc gaa ggc gct	835
Val Ala Val Phe Phe Leu Val Phe Ala Phe Gln Glu Gly Glu Gly Ala	
230 235 240 245	
ggc tgg gcg gca tgg gtg tgg atc atg atc gta gcc gcc ttt gcg ctc	883
Gly Trp Ala Ala Trp Val Trp Ile Met Ile Val Ala Ala Phe Ala Leu	
250 255 260	
ttt gcg tgg ttt atc tac caa caa agc agg gcc gag aaa tcc gga aac	931
Phe Ala Trp Phe Ile Tyr Gln Gln Ser Arg Ala Glu Lys Ser Gly Asn	
265 270 275	
gat cct ctc gtc cca ctg gag att ttc aag ttt aga aac ttc agc ctc	979
Asp Pro Leu Val Pro Leu Glu Ile Phe Lys Phe Arg Asn Phe Ser Leu	
280 285 290	
ggc aat atc tgc atc atg gcc atg gga ttc acc gtg gct ggt act cct	1027
Gly Asn Ile Cys Ile Met Ala Met Gly Phe Thr Val Ala Gly Thr Pro	
295 300 305	

ctg ccc atc atg ttg tac ttc cag caa gca cac gga atg aac gcc atg 1075  
 Leu Pro Ile Met Leu Tyr Phe Gln Gln Ala His Gly Met Asn Ala Met  
 310 315 320 325

gaa gcg ggt ttc atg atg gtg cct caa gct ctc atg gca gca gta ctg 1123  
 Glu Ala Gly Phe Met Met Val Pro Gln Ala Leu Met Ala Ala Val Leu  
 330 335 340

tca cca ttt gtt gga aag ctg gtt gat cga tcc aac cct gga ctc atg 1171  
 Ser Pro Phe Val Gly Lys Leu Val Asp Arg Ser Asn Pro Gly Leu Met  
 345 350 355

gca gcc ctc ggt ttt agc aca gtg gct gtg tcc att gta ctg ctg tca 1219  
 Ala Ala Leu Gly Phe Ser Thr Val Ala Val Ser Ile Val Leu Leu Ser  
 360 365 370

atg gta atg att ttc gat acg ggt cta gtc tgg gca ctt gtt tcg atg 1267  
 Met Val Met Ile Phe Asp Thr Gly Leu Val Trp Ala Leu Val Ser Met  
 375 380 385

act ttg ctc ggc atc gga aac gcc ttt gtg tgg gca ccg aac tcg acc 1315  
 Thr Leu Leu Gly Ile Gly Asn Ala Phe Val Trp Ala Pro Asn Ser Thr  
 390 395 400 405

tcc act atg cgc gac ctg cca cac aag ttc atg gga gcg ggc tct ggc 1363  
 Ser Thr Met Arg Asp Leu Pro His Lys Phe Met Gly Ala Gly Ser Gly  
 410 415 420

gtg ttc aat aca acc cgc caa tta ggt tca gtc atc ggc gcc gct gcc 1411  
 Val Phe Asn Thr Thr Arg Gln Leu Gly Ser Val Ile Gly Ala Ala Ala  
 425 430 435

atc ggc gcg gta atg cag att cga ctg gca gca ggc gat gag ggc gca 1459  
 Ile Gly Ala Val Met Gln Ile Arg Leu Ala Ala Gly Asp Glu Gly Ala  
 440 445 450

gct ttt ggt caa gca ctt cta ctt gcc gct gcg gtg ctg gtt atc ggc 1507  
 Ala Phe Gly Gln Ala Leu Leu Leu Ala Ala Val Leu Val Ile Gly  
 455 460 465

att gtg gca tca acg atg gca gga aaa aat gca cac cca gcg ccg gta 1555  
 Ile Val Ala Ser Thr Met Ala Gly Lys Asn Ala His Pro Ala Pro Val  
 470 475 480 485

aag cct taaaggctcg atgaatcctt cga 1584  
 Lys Pro

&lt;210&gt; 238

&lt;211&gt; 487

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 238

Val Ser Asp Lys Lys Gln Asp Leu Thr Ser Ser Ala Ala Gly Ser Ala  
 1 5 10 15



Ala Pro Gln Thr Lys Ala Tyr Pro Ala Met Pro Leu Pro Glu Lys Gln  
 20 25 30  
 Ala Trp Pro Ala Leu Ile Ala Leu Cys Ile Gly Phe Phe Met Ile Leu  
 35 40 45  
 Leu Asp Gln Thr Ile Val Ala Val Ser Thr Pro Ala Leu Gln Ala Asp  
 50 55 60  
 Met Gly Ala Ser Tyr Asn Glu Val Ile Trp Val Thr Ser Val Tyr Leu  
 65 70 75 80  
 Leu Thr Phe Ala Val Pro Leu Leu Val Thr Gly Arg Leu Gly Asp Lys  
 85 90 95  
 Tyr Gly Pro Lys Asn Val Tyr Val Ala Gly Met Val Ile Phe Thr Val  
 100 105 110  
 Ser Ser Leu Ala Cys Gly Leu Ala Pro Asp Met Phe Thr Leu Ile Ile  
 115 120 125  
 Ala Arg Gly Val Gln Gly Leu Gly Ala Ala Leu Leu Thr Pro Gln Thr  
 130 135 140  
 Met Ala Thr Ile Asn Arg Ile Phe Ala Phe Glu Arg Arg Gly Ala Ala  
 145 150 155 160  
 Leu Gly Val Trp Gly Ser Thr Ala Gly Leu Ala Ser Leu Ala Gly Pro  
 165 170 175  
 Ile Leu Gly Gly Val Ile Thr Glu Asn Trp Gly Trp Gln Trp Val Phe  
 180 185 190  
 Tyr Ile Asn Val Pro Ile Gly Val Ile Ser Val Ile Ala Val Met Lys  
 195 200 205  
 Tyr Val Pro Glu Phe Pro Pro Leu Thr Arg Pro Leu Asp Pro Leu Ser  
 210 215 220  
 Ile Val Leu Ser Ile Val Ala Val Phe Phe Leu Val Phe Ala Phe Gln  
 225 230 235 240  
 Glu Gly Glu Gly Ala Gly Trp Ala Ala Trp Val Trp Ile Met Ile Val  
 245 250 255  
 Ala Ala Phe Ala Leu Phe Ala Trp Phe Ile Tyr Gln Gln Ser Arg Ala  
 260 265 270  
 Glu Lys Ser Gly Asn Asp Pro Leu Val Pro Leu Glu Ile Phe Lys Phe  
 275 280 285  
 Arg Asn Phe Ser Leu Gly Asn Ile Cys Ile Met Ala Met Gly Phe Thr  
 290 295 300  
 Val Ala Gly Thr Pro Leu Pro Ile Met Leu Tyr Phe Gln Gln Ala His  
 305 310 315 320

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<400> 239
tggagccttg tcttcctcca gcaatccac aacggagcag gttgggatcc cgagaaatgt 60
tgatcatcatc ttggctgtat tagtttttac agcctttgtc atg atg ttg aat gag 115
                                         Met Met Leu Asn Glu
                                         1                               5
act act ctg gca gtc gcg ttg ccg tcg atc atg gcg gac ttt gac att 163
Thr Thr Leu Ala Val Ala Leu Pro Ser Ile Met Ala Asp Phe Asp Ile
              10                               15                               20
gag gcg aat act gcg cag tgg ttg ctc act ggt ttt atg ttg acc atg 211

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Glu	Ala	Asn	Thr	Ala	Gln	Trp	Leu	Leu	Thr	Gly	Phe	Met	Leu	Thr	Met		
			25					30					35				
gct	gtg	gtt	ctt	cca	gct	act	ggt	tgg	atg	ttg	gaa	cgt	ttt	acc	act	259	
Ala	Val	Val	Leu	Pro	Ala	Thr	Gly	Trp	Met	Leu	Glu	Arg	Phe	Thr	Thr		
		40					45					50					
cgt	agt	gtg	ttt	att	ttc	gcc	acg	gtg	gtc	ttc	ctg	atc	ggt	act	gtg	307	
Arg	Ser	Val	Phe	Ile	Phe	Ala	Thr	Val	Val	Phe	Leu	Ile	Gly	Thr	Val		
	55					60					65						
acg	gct	gcg	ttg	tct	cct	act	ttt	gcg	att	atg	ctt	gca	gcc	cgc	gtc	355	
Thr	Ala	Ala	Leu	Ser	Pro	Thr	Phe	Ala	Ile	Met	Leu	Ala	Ala	Arg	Val		
70					75				80						85		
gct	cag	gcg	att	ggt	acc	gct	gtg	atc	atg	ccg	ctg	ctg	atg	act	gtc	403	
Ala	Gln	Ala	Ile	Gly	Thr	Ala	Val	Ile	Met	Pro	Leu	Leu	Met	Thr	Val		
			90					95						100			
gcg	atg	acc	gtt	gtt	cct	cca	gag	cgc	cgt	ggc	gcc	gtc	atg	ggt	ttg	451	
Ala	Met	Thr	Val	Val	Pro	Pro	Glu	Arg	Arg	Gly	Ala	Val	Met	Gly	Leu		
		105					110					115					
att	gcg	gtc	gtg	atg	gcc	gtt	ggt	cct	gct	ctt	gga	cct	agt	gtg	gct	499	
Ile	Ala	Val	Val	Met	Ala	Val	Gly	Pro	Ala	Leu	Gly	Pro	Ser	Val	Ala		
	120						125					130					
ggt	ttc	gta	ctc	agc	ttg	tct	tcg	tgg	cac	gcg	att	ttc	tgg	gtc	atg	547	
Gly	Phe	Val	Leu	Ser	Leu	Ser	Ser	Trp	His	Ala	Ile	Phe	Trp	Val	Met		
	135				140						145						
gtt	ccg	ttg	gtg	ttt	gtg	gca	agc	ctg	atc	ggt	acc	ctg	cgt	ctg	acc	595	
Val	Pro	Leu	Val	Phe	Val	Ala	Ser	Leu	Ile	Gly	Thr	Leu	Arg	Leu	Thr		
150					155					160					165		
aac	gtc	agt	gag	cct	aaa	aag	act	cct	ttg	gat	gtt	att	tcc	ttc	ctg	643	
Asn	Val	Ser	Glu	Pro	Lys	Lys	Thr	Pro	Leu	Asp	Val	Ile	Ser	Phe	Leu		
			170					175						180			
att	tcc	gca	gtg	gct	ttc	ggt	ggc	ctt	gtg	tac	gcc	ttg	agc	tcg	att	691	
Ile	Ser	Ala	Val	Ala	Phe	Gly	Gly	Leu	Val	Tyr	Ala	Leu	Ser	Ser	Ile		
		185					190						195				
ggc	atc	att	ttg	gaa	ggt	gac	aga	agc	gct	ttg	gtc	gtg	ttg	gct	gtc	739	
Gly	Ile	Ile	Leu	Glu	Gly	Asp	Arg	Ser	Ala	Leu	Val	Val	Leu	Ala	Val		
	200					205						210					
ggc	atc	att	gcg	ttg	gtg	gtg	ttt	gtg	tgg	cgc	cag	att	gcc	atg	ggt	787	
Gly	Ile	Ile	Ala	Leu	Val	Val	Phe	Val	Trp	Arg	Gln	Ile	Ala	Met	Gly		
	215					220					225						
aag	cag	gat	aag	gcg	ctg	ttg	gat	ctg	cgt	ccg	ttg	gcg	att	cgt	gag	835	
Lys	Gln	Asp	Lys	Ala	Leu	Leu	Asp	Leu	Arg	Pro	Leu	Ala	Ile	Arg	Glu		
230					235					240					245		
tac	acc	att	ccg	ctg	gtt	gtg	ctt	ttg	acg	ctg	ttc	ggt	gcg	ctg	ctc	883	
Tyr	Thr	Ile	Pro	Leu	Val	Val	Leu	Leu	Thr	Leu	Phe	Gly	Ala	Leu	Leu		

250	255	260	
ggt gtc atg aat aca ctg ccg ctc tac ctg cag gga tcc ttg atg gtc Gly Val Met Asn Thr Leu Pro Leu Tyr Leu Gln Gly Ser Leu Met Val 265 270 275			931
acc gcc ttg gtc gcg ggt cta gtg ctg ttg cca ggt ggt ctt ttg gaa Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro Gly Gly Leu Leu Glu 280 285 290			979
ggt gtg ctg tcg cca ttt gtg ggt cga att tat gat cgt cat ggt cca Gly Val Leu Ser Pro Phe Val Gly Arg Ile Tyr Asp Arg His Gly Pro 295 300 305			1027
cgc gga ctc gtg atc ggc ggt atg tca ctc gtt gtg atc tcc ctg ttt Arg Gly Leu Val Ile Gly Gly Met Ser Leu Val Val Ile Ser Leu Phe 310 315 320 325			1075
gca ctg tcc acc gtc gat gag ttc gcc aac gtg tgg ttc atc atc ggc Ala Leu Ser Thr Val Asp Glu Phe Ala Asn Val Trp Phe Ile Ile Gly 330 335 340			1123
gta cac atc gtg ttc tcc atc ggc .ctt gcg ctg ctg ttc acc cca ctg Val His Ile Val Phe Ser Ile Gly Leu Ala Leu Leu Phe Thr Pro Leu 345 350 355			1171
atg aca gtc gcg ctc gca tcc gtc ccc gac aac atg tac ggc cac ggc Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn Met Tyr Gly His Gly 360 365 370			1219
tcc gcg atc ctc aac acc ctc caa cag ctc gcc ggc gcc gca ggc acc Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala Gly Ala Ala Gly Thr 375 380 385			1267
gcg gtc atg att gcg gtt tat tcc acc gtc agc aac aac gcg ctt atc Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser Asn Asn Ala Leu Ile 390 395 400 405			1315
gac ggc gca acc caa caa acc gcc ctc gcc gac ggc gcc aac tct gca Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp Gly Ala Asn Ser Ala 410 415 420			1363
ttc ttc gcc tca gcg tgc gtg gca gtg ttt gca ctg atc gtg ggc ttc Phe Phe Ala Ser Ala Cys Val Ala Val Phe Ala Leu Ile Val Gly Phe 425 430 435			1411
ttt gta aag agg cca gcc cgc taagctaggt cgcatgatca gca Phe Val Lys Arg Pro Ala Arg 440			1455

&lt;210&gt; 240

&lt;211&gt; 444

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 240

Met	Met	Leu	Asn	Glu	Thr	Thr	Leu	Ala	Val	Ala	Leu	Pro	Ser	Ile	Met	
1				5					10					15		
Ala	Asp	Phe	Asp	Ile	Glu	Ala	Asn	Thr	Ala	Gln	Trp	Leu	Leu	Thr	Gly	
			20					25					30			
Phe	Met	Leu	Thr	Met	Ala	Val	Val	Leu	Pro	Ala	Thr	Gly	Trp	Met	Leu	
		35					40					45				
Glu	Arg	Phe	Thr	Thr	Arg	Ser	Val	Phe	Ile	Phe	Ala	Thr	Val	Val	Phe	
	50					55					60					
Leu	Ile	Gly	Thr	Val	Thr	Ala	Ala	Leu	Ser	Pro	Thr	Phe	Ala	Ile	Met	
65					70				75						80	
Leu	Ala	Ala	Arg	Val	Ala	Gln	Ala	Ile	Gly	Thr	Ala	Val	Ile	Met	Pro	
				85					90					95		
Leu	Leu	Met	Thr	Val	Ala	Met	Thr	Val	Val	Pro	Pro	Glu	Arg	Arg	Gly	
			100					105					110			
Ala	Val	Met	Gly	Leu	Ile	Ala	Val	Val	Met	Ala	Val	Gly	Pro	Ala	Leu	
		115					120					125				
Gly	Pro	Ser	Val	Ala	Gly	Phe	Val	Leu	Ser	Leu	Ser	Ser	Trp	His	Ala	
		130				135					140					
Ile	Phe	Trp	Val	Met	Val	Pro	Leu	Val	Phe	Val	Ala	Ser	Leu	Ile	Gly	
145					150					155					160	
Thr	Leu	Arg	Leu	Thr	Asn	Val	Ser	Glu	Pro	Lys	Lys	Thr	Pro	Leu	Asp	
				165					170					175		
Val	Ile	Ser	Phe	Leu	Ile	Ser	Ala	Val	Ala	Phe	Gly	Gly	Leu	Val	Tyr	
			180					185					190			
Ala	Leu	Ser	Ser	Ile	Gly	Ile	Ile	Leu	Glu	Gly	Asp	Arg	Ser	Ala	Leu	
		195					200				205					
Val	Val	Leu	Ala	Val	Gly	Ile	Ile	Ala	Leu	Val	Val	Phe	Val	Trp	Arg	
		210				215					220					
Gln	Ile	Ala	Met	Gly	Lys	Gln	Asp	Lys	Ala	Leu	Leu	Asp	Leu	Arg	Pro	
225					230					235					240	
Leu	Ala	Ile	Arg	Glu	Tyr	Thr	Ile	Pro	Leu	Val	Val	Leu	Leu	Thr	Leu	
				245					250					255		
Phe	Gly	Ala	Leu	Leu	Gly	Val	Met	Asn	Thr	Leu	Pro	Leu	Tyr	Leu	Gln	
			260					265					270			
Gly	Ser	Leu	Met	Val	Thr	Ala	Leu	Val	Ala	Gly	Leu	Val	Leu	Leu	Pro	
		275					280					285				
Gly	Gly	Leu	Leu	Glu	Gly	Val	Leu	Ser	Pro	Phe	Val	Gly	Arg	Ile	Tyr	
		290				295					300					

Asp Arg His Gly Pro Arg Gly Leu Val Ile Gly Gly Met Ser Leu Val  
 305 310 315 320  
 Val Ile Ser Leu Phe Ala Leu Ser Thr Val Asp Glu Phe Ala Asn Val  
 325 330 335  
 Trp Phe Ile Ile Gly Val His Ile Val Phe Ser Ile Gly Leu Ala Leu  
 340 345 350  
 Leu Phe Thr Pro Leu Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn  
 355 360 365  
 Met Tyr Gly His Gly Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala  
 370 375 380  
 Gly Ala Ala Gly Thr Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser  
 385 390 395 400  
 Asn Asn Ala Leu Ile Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp  
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 Met Met Leu Asn Glu  
 1 5  
 act act ctg gca gtc gcg ttg ccg tcg atc atg gcg gac ttt gac att 163  
 Thr Thr Leu Ala Val Ala Leu Pro Ser Ile Met Ala Asp Phe Asp Ile  
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 gag gcg aat act gcg cag tgg ttg ctc act ggt ttt atg ttg acc atg 211  
 Glu Ala Asn Thr Ala Gln Trp Leu Leu Thr Gly Phe Met Leu Thr Met  
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 gct gtg gtt ctt cca gct act ggt tgg atg ttg gaa cgt ttt acc act 259  
 Ala Val Val Leu Pro Ala Thr Gly Trp Met Leu Glu Arg Phe Thr Thr  
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Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro Gly Gly Leu Leu Glu  
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 Gly Val Leu Ser Pro Phe Val Gly Arg Ile Tyr Asp Arg His Gly Pro  
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cgc gga ctc gtg atc ggc ggt atg tca ctc gtt gtg atc tcc ctg ttt 1075  
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 Ala Leu Ser Thr Val Asp  
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<211> 331

<212> PRT

<213> Corynebacterium glutamicum

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Phe Met Leu Thr Met Ala Val Val Leu Pro Ala Thr Gly Trp Met Leu  
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Glu Arg Phe Thr Thr Arg Ser Val Phe Ile Phe Ala Thr Val Val Phe  
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Leu Ile Gly Thr Val Thr Ala Ala Leu Ser Pro Thr Phe Ala Ile Met  
 65 70 75 80

Leu Ala Ala Arg Val Ala Gln Ala Ile Gly Thr Ala Val Ile Met Pro  
 85 90 95

Leu Leu Met Thr Val Ala Met Thr Val Val Pro Pro Glu Arg Arg Gly  
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Ala Val Met Gly Leu Ile Ala Val Val Met Ala Val Gly Pro Ala Leu  
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Gly Pro Ser Val Ala Gly Phe Val Leu Ser Leu Ser Ser Trp His Ala  
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Ile Phe Trp Val Met Val Pro Leu Val Phe Val Ala Ser Leu Ile Gly  
 145 150 155 160

Thr Leu Arg Leu Thr Asn Val Ser Glu Pro Lys Lys Thr Pro Leu Asp  
 165 170 175

Val Ile Ser Phe Leu Ile Ser Ala Val Ala Phe Gly Gly Leu Val Tyr  
 180 185 190

Ala Leu Ser Ser Ile Gly Ile Ile Leu Glu Gly Asp Arg Ser Ala Leu  
 195 200 205

Val Val Leu Ala Val Gly Ile Ile Ala Leu Val Val Phe Val Trp Arg  
 210 215 220

Gln Ile Ala Met Gly Lys Gln Asp Lys Ala Leu Leu Asp Leu Arg Pro  
 225 230 235 240

Leu Ala Ile Arg Glu Tyr Thr Ile Pro Leu Val Val Leu Leu Thr Leu  
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Phe Gly Ala Leu Leu Gly Val Met Asn Thr Leu Pro Leu Tyr Leu Gln  
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Gly Ser Leu Met Val Thr Ala Leu Val Ala Gly Leu Val Leu Leu Pro  
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 Asp Thr Ser Trp Phe Ser Ser Ala Leu Ala Leu Leu Phe Thr Pro Leu  
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 Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn Met Tyr Gly His Gly  
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 Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala Gly Ala Ala Gly Thr  
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gcg gtc atg att gcg gtt tat tcc acc gtc agc aac aac gcg ctt atc 240

Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser Asn Asn Ala Leu Ile  
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 Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp Gly Ala Asn Ser Ala  
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 Phe Phe Ala Ser Ala Cys Val Ala Val Phe Ala Leu Ile Val Gly Phe  
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Met Thr Val Ala Leu Ala Ser Val Pro Asp Asn Met Tyr Gly His Gly  
 35 40 45

Ser Ala Ile Leu Asn Thr Leu Gln Gln Leu Ala Gly Ala Ala Gly Thr  
 50 55 60

Ala Val Met Ile Ala Val Tyr Ser Thr Val Ser Asn Asn Ala Leu Ile  
 65 70 75 80

Asp Gly Ala Thr Gln Gln Thr Ala Leu Ala Asp Gly Ala Asn Ser Ala  
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 Val Val Thr Leu Ala  
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tca gct ggt atc act gtt tcc cta gcg cag acc ctg gtt att ccg atc 163  
 Ser Ala Gly Ile Thr Val Ser Leu Ala Gln Thr Leu Val Ile Pro Ile  
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 Ile Gly Arg Leu Pro Glu Ile Phe Asn Thr Thr Ala Ala Asn Ala Ser  
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tgg atc att act gtg acg ctg ttg gtg ggc gca gtg gcg act cct gtg 259  
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 Ser Leu Val Pro Phe Ile Leu Gly Ser Val Ile Cys Ala Val Ser Val  
 70 75 80 85

gat ttg att ccg atg atc atc ggc cgt ggt ttt cag ggg ctt ggc tct 403  
 Asp Leu Ile Pro Met Ile Ile Gly Arg Gly Phe Gln Gly Leu Gly Ser  
 90 95 100

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 Gly Leu Ile Pro Leu Gly Ile Ser Leu Met His Asp Leu Leu Pro Arg  
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 Glu Lys Ala Gly Ser Ala Ile Ala Leu Met Ser Ser Ser Met Gly Ile  
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 Ser Trp Arg Val Leu Phe Trp Phe Thr Ala Leu Val Ala Leu Thr Val  
 150 155 160 165

ggc gcg gtc att tgg aag gcg att cct gct aga ccc agg atc gtg agg 643  
 Gly Ala Val Ile Trp Lys Ala Ile Pro Ala Arg Pro Arg Ile Val Arg  
 170 175 180

agt ggc ggc ttt gat tat ttc ggt gct ctc ggc ctt gca atg gga ctt 691  
 Ser Gly Gly Phe Asp Tyr Phe Gly Ala Leu Gly Leu Ala Met Gly Leu  
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atc gca ttg ttg ctc gcg gtg tcc aag gga tca gaa tgg ggc tgg aga 739  
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 Ala Val Ile Ser Tyr Phe Ile Pro Thr Thr Thr Thr Val Val Glu Ala  
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 Lys  
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Ala Ala Asn Ala Ser Trp Ile Ile Thr Val Thr Leu Leu Val Gly Ala  
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Val Ala Thr Pro Val Met Gly Arg Leu Ala Asp Met Tyr Gly Lys Lys  
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Lys Met Met Leu Ile Ser Leu Val Pro Phe Ile Leu Gly Ser Val Ile  
       65                          70                          75                          80

Cys Ala Val Ser Val Asp Leu Ile Pro Met Ile Ile Gly Arg Gly Phe  
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Gln Gly Leu Gly Ser Gly Leu Ile Pro Leu Gly Ile Ser Leu Met His  
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Asp Leu Leu Pro Arg Glu Lys Ala Gly Ser Ala Ile Ala Leu Met Ser  
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Ser Ser Met Gly Ile Gly Gly Ala Leu Gly Leu Pro Leu Ala Ala Ala  
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Ile Ala Gln Phe Ala Ser Trp Arg Val Leu Phe Trp Phe Thr Ala Leu  
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Val Ala Leu Thr Val Gly Ala Val Ile Trp Lys Ala Ile Pro Ala Arg  
           165                          170                          175

Pro Arg Ile Val Arg Ser Gly Gly Phe Asp Tyr Phe Gly Ala Leu Gly  
           180                          185                          190

Leu Ala Met Gly Leu Ile Ala Leu Leu Leu Ala Val Ser Lys Gly Ser

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Pro	Leu	Ile	Asp	Leu	Arg	Thr	Thr	Ile	Arg	Ala	Thr	Val	Leu	Met	Thr
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Ile	Leu	Pro	Gln	Val	Met	Gln	Leu	Pro	Val	Ile	Leu	Gly	Tyr	Gly	Leu
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Gly	Gln	Ser	Met	Leu	Gln	Met	Gly	Ile	Trp	Leu	Ile	Pro	Met	Gly	Leu
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Gly	Met	Met	Leu	Ile	Ser	Asn	Ala	Gly	Ala	Ala	Ile	Ser	Ala	Ala	His
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Gly	Pro	Arg	Val	Thr	Leu	Thr	Ile	Ala	Gly	Val	Val	Ile	Ala	Val	Gly
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		370				375					380				
Ser	Met	Pro	Ala	Leu	Ile	Met	Gly	Ala	Val	Pro	Ala	Thr	Glu	Lys	Ala
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Val	Pro	Thr	Leu	Gly	Gly	Phe	Met	Thr	Thr	Leu	Ile	Ile	Gly	Cys	Cys
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<213> *Corynebacterium glutamicum*

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&lt;221&gt; CDS

&lt;222&gt; (101)..(1747)

&lt;223&gt; RXN01320

&lt;400&gt; 247

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Lys Pro Asp Asp Glu Arg Pro Val Thr Thr Ile Ser Lys Ser Gly Ala
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Pro Ser Ala His Thr Ser Ala Pro Tyr Gly Ala Ala Ala Thr Glu Glu
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Ala Val Glu Glu Lys Thr Lys Gly Arg Val Gly Phe Ile Ile Ala Ala
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Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg Lys Tyr Leu Phe Met
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Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile Gly Thr Ser Thr Val	
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Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr Lys Trp Tyr Pro Phe	
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Ile Gly Met Leu Ile Met Val Leu Ala Leu Val Leu Leu Ser Thr Leu	
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Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu Tyr Phe Phe Val Phe	
390 395 400 405	

gga ttc ggc ctg ggc tgt gca atg cag att ttg gtt ctc atc gtg cag 1363  
 Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu Val Leu Ile Val Gln  
 410 415 420

aac tcc ttc cca atc acc atg gtt ggc acc gcg acc ggt tcc aac aac 1411  
 Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala Thr Gly Ser Asn Asn  
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ttc ttc cgc caa atc ggt gga gca gta ggt tcc gca ctg atc ggt ggc 1459  
 Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser Ala Leu Ile Gly Gly  
 440 445 450

ctg ttt atc tcc aac ctg tcc gac cga ttc acc gaa aac gtc ccc gca 1507  
 Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr Glu Asn Val Pro Ala  
 455 460 465

gca gtg gct tcc atg ggt gaa gaa ggc gca caa tac gcc tca gca atg 1555  
 Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln Tyr Ala Ser Ala Met  
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tcc gat ttc tcc ggt gca tcc aac ctc act cca cac ctt gtt gaa tca 1603  
 Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro His Leu Val Glu Ser  
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 Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu Ser Tyr Asn Asp Ala  
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ctg aca cca atc ttc ttg gcg ctc acc ccg atc gca gta gtc gcc gcg 1699  
 Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile Ala Val Val Ala Ala  
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atc ctc ctc ttt ttc atc cgt gaa gat cac ctc aag gaa acg cac gaa 1747  
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 Phe Ile Ile Ala Ala Leu Met Leu Ala Met Leu Leu Ser Ser Leu Gly  
 50 55 60

Gln Thr Ile Phe Gly Ser Ala Leu Pro Thr Ile Val Gly Glu Leu Gly  
 65 70 75 80  
 Gly Val Asn His Met Thr Trp Val Ile Thr Ala Phe Leu Leu Gly Gln  
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 Thr Ile Ser Leu Pro Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg  
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 Lys Tyr Leu Phe Met Phe Ala Ile Ala Leu Phe Val Val Gly Ser Ile  
 115 120 125  
 Ile Gly Ala Leu Ala Gln Asn Met Thr Thr Leu Ile Val Ala Arg Ala  
 130 135 140  
 Leu Gln Gly Ile Ala Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile  
 145 150 155 160  
 Thr Ala Asp Val Thr Thr Ala Arg Glu Arg Ala Lys Tyr Met Gly Ile  
 165 170 175  
 Met Gly Ser Val Phe Gly Leu Ser Ser Ile Leu Gly Pro Leu Leu Gly  
 180 185 190  
 Gly Trp Phe Thr Asp Gly Pro Gly Trp Arg Trp Gly Leu Trp Leu Asn  
 195 200 205  
 Val Pro Ile Gly Ile Ile Ala Leu Val Ala Ile Ala Val Leu Leu Lys  
 210 215 220  
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 225 230 235 240  
 Ile Phe Met Ala Ile Ala Thr Thr Ala Phe Val Leu Ala Val Thr Trp  
 245 250 255  
 Gly Gly Asn Glu Tyr Glu Trp Ala Ser Pro Met Ile Ile Gly Leu Phe  
 260 265 270  
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 275 280 285  
 Ala Val Asp Pro Leu Val Pro Met Gly Leu Phe Ser Asn Arg Asn Phe  
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 305 310 315 320  
 Thr Ile Ala Tyr Met Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn  
 325 330 335  
 Pro Thr Gln Ala Gly Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile  
 340 345 350  
 Gly Thr Ser Thr Val Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr  
 355 360 365

Lys Trp Tyr Pro Phe Ile Gly Met Leu Ile Met Val Leu Ala Leu Val  
370 375 380

Leu Leu Ser Thr Leu Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu  
385 390 395 400

Tyr Phe Phe Val Phe Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu  
405 410 415

Val Leu Ile Val Gln Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala  
420 425 430

Thr Gly Ser Asn Asn Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser  
435 440 445

Ala Leu Ile Gly Gly Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr  
450 455 460

Glu Asn Val Pro Ala Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln  
465 470 475 480

Tyr Ala Ser Ala Met Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro  
485 490 495

His Leu Val Glu Ser Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu  
500 505 510

Ser Tyr Asn Asp Ala Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile  
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Lys Glu Thr His Glu  
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<223> FRXA01314

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Met Thr Ser Gln Val  
1 5

aag ccg gac gac gaa cgt ccg gta aca aca att tca aaa agt ggt gca 163  
Lys Pro Asp Asp Glu Arg Pro Val Thr Thr Ile Ser Lys Ser Gly Ala  
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cct tcg gcc cac acc tca gca cca tat ggt gca gca gca act gaa gaa	211
Pro Ser Ala His Thr Ser Ala Pro Tyr Gly Ala Ala Ala Thr Glu Glu	
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gct gtc gag gaa aaa acc aaa ggt cgc gtt gga ttt atc atc gca gcc	259
Ala Val Glu Glu Lys Thr Lys Gly Arg Val Gly Phe Ile Ile Ala Ala	
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Leu Met Leu Ala Met Leu Leu Ser Ser Leu Gly Gln Thr Ile Phe Gly	
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tct gcc ctg cca acg att gtt ggt gag ctt ggc ggc gtt aac cac atg	355
Ser Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asn His Met	
70 75 80 85	
acc tgg gtg att acc gcc ttc ctc ttg ggc cag acc att tca ttg cct	403
Thr Trp Val Ile Thr Ala Phe Leu Leu Gly Gln Thr Ile Ser Leu Pro	
90 95 100	
att ttc ggc aag ttg ggt gac cag ttt ggt cgc aaa tac ctc ttc atg	451
Ile Phe Gly Lys Leu Gly Asp Gln Phe Gly Arg Lys Tyr Leu Phe Met	
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ttt gcc atc gca ctg ttc gtg gtg ggt tcc atc atc ggt gct ttg gct	499
Phe Ala Ile Ala Leu Phe Val Val Gly Ser Ile Ile Gly Ala Leu Ala	
120 125 130	
cag aac atg acc acc ttg att gtg gct cgt gca ctg cag ggt atc gcc	547
Gln Asn Met Thr Thr Leu Ile Val Ala Arg Ala Leu Gln Gly Ile Ala	
135 140 145	
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Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Thr Ala Asp Val Thr	
150 155 160 165	
acc gcc cgt gag cgt gca aag tac atg ggc atc atg ggt tcc gtt ttc	643
Thr Ala Arg Glu Arg Ala Lys Tyr Met Gly Ile Met Gly Ser Val Phe	
170 175 180	
gga ctg tcc tcc atc ctt ggc cca ttg ctt ggt ggc tgg ttc act gac	691
Gly Leu Ser Ser Ile Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr Asp	
185 190 195	
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Gly Pro Gly Trp Arg Trp Gly Leu Trp Leu Asn Val Pro Ile Gly Ile	
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Ile Ala Leu Val Ala Ile Ala Val Leu Leu Lys Leu Pro Ala Arg Glu	
215 220 225	
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Ala Thr

841

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<400> 250

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Ala	Ala	Thr	Glu	Glu	Ala	Val	Glu	Glu	Lys	Thr	Lys	Gly	Arg	Val	Gly
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Phe	Ile	Ile	Ala	Ala	Leu	Met	Leu	Ala	Met	Leu	Leu	Ser	Ser	Leu	Gly
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Gln	Thr	Ile	Phe	Gly	Ser	Ala	Leu	Pro	Thr	Ile	Val	Gly	Glu	Leu	Gly
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Gly	Val	Asn	His	Met	Thr	Trp	Val	Ile	Thr	Ala	Phe	Leu	Leu	Gly	Gln
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Thr	Ile	Ser	Leu	Pro	Ile	Phe	Gly	Lys	Leu	Gly	Asp	Gln	Phe	Gly	Arg
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Lys	Tyr	Leu	Phe	Met	Phe	Ala	Ile	Ala	Leu	Phe	Val	Val	Gly	Ser	Ile
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	130					135					140				
Leu	Gln	Gly	Ile	Ala	Gly	Gly	Gly	Leu	Met	Ile	Leu	Ser	Gln	Ala	Ile
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Thr	Ala	Asp	Val	Thr	Thr	Ala	Arg	Glu	Arg	Ala	Lys	Tyr	Met	Gly	Ile
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Met	Gly	Ser	Val	Phe	Gly	Leu	Ser	Ser	Ile	Leu	Gly	Pro	Leu	Leu	Gly
			180					185					190		
Gly	Trp	Phe	Thr	Asp	Gly	Pro	Gly	Trp	Arg	Trp	Gly	Leu	Trp	Leu	Asn
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Val	Pro	Ile	Gly	Ile	Ile	Ala	Leu	Val	Ala	Ile	Ala	Val	Leu	Leu	Lys
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Leu	Pro	Ala	Arg	Glu	Arg	Gly	Lys	Val	Ser	Val	Asp	Trp	Leu	Gly	Ser
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Ile	Phe	Met	Ala	Ile	Ala	Thr									



245

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Leu Thr Ala Val Ala Gly Ile Gly Val Gly Leu Phe Met Met Gly Thr	
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atc gcg tac atg cct acc tac ctg cag atg gtt cat ggt ctg aac cca	144
Ile Ala Tyr Met Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn Pro	
35 40 45	
acg caa gct ggt ctg atg ctg atc cca atg atg atc ggc ctg att ggt	192
Thr Gln Ala Gly Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile Gly	
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Thr Ser Thr Val Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr Lys	
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Trp Tyr Pro Phe Ile Gly Met Leu Ile Met Val Leu Ala Leu Val Leu	
85 90 95	
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Leu Ser Thr Leu Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu Tyr	
100 105 110	
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Phe Phe Val Phe Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu Val	
115 120 125	
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Leu Ile Val Gln Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala Thr	
130 135 140	
ggt tcc aac aac ttc ttc cgc caa atc ggt gga gca gta ggt tcc gca	480
Gly Ser Asn Asn Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser Ala	
145 150 155 160	
ctg atc ggt ggc ctg ttt atc tcc aac ctg tcc gac cga ttc acc gaa	528
Leu Ile Gly Gly Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr Glu	
165 170 175	

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 Asn Val Pro Ala Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln Tyr  
 180 185 190

gcc tca gca atg tcc gat ttc tcc ggt gca tcc aac ctc act cca cac 624  
 Ala Ser Ala Met Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro His  
 195 200 205

ctt gtt gaa tca ctt cca caa gca ctc cgt gaa gca att caa ctt tct 672  
 Leu Val Glu Ser Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu Ser  
 210 215 220

tac aac gac gcc ctg aca cca atc ttc ttg gcg ctc acc ccg atc gca 720  
 Tyr Asn Asp Ala Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile Ala  
 225 230 235 240

gta gtc gcc gcg atc ctc ctc ttt ttc atc cgt gaa gat cac ctc aag 768  
 Val Val Ala Ala Ile Leu Leu Phe Phe Ile Arg Glu Asp His Leu Lys  
 245 250 255

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 Glu Thr His Glu  
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Ile Ala Tyr Met Pro Thr Tyr Leu Gln Met Val His Gly Leu Asn Pro  
 35 40 45

Thr Gln Ala Gly Leu Met Leu Ile Pro Met Met Ile Gly Leu Ile Gly  
 50 55 60

Thr Ser Thr Val Val Gly Asn Ile Val Ser Lys Thr Gly Lys Tyr Lys  
 65 70 75 80

Trp Tyr Pro Phe Ile Gly Met Leu Ile Met Val Leu Ala Leu Val Leu  
 85 90 95

Leu Ser Thr Leu Thr Pro Ser Ala Ser Leu Ala Leu Ile Gly Leu Tyr  
 100 105 110

Phe Phe Val Phe Gly Phe Gly Leu Gly Cys Ala Met Gln Ile Leu Val  
 115 120 125

Leu Ile Val Gln Asn Ser Phe Pro Ile Thr Met Val Gly Thr Ala Thr

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Gly Ser Asn Asn Phe Phe Arg Gln Ile Gly Gly Ala Val Gly Ser Ala				
145		150		155
Leu Ile Gly Gly Leu Phe Ile Ser Asn Leu Ser Asp Arg Phe Thr Glu				
	165		170	175
Asn Val Pro Ala Ala Val Ala Ser Met Gly Glu Glu Gly Ala Gln Tyr				
	180		185	190
Ala Ser Ala Met Ser Asp Phe Ser Gly Ala Ser Asn Leu Thr Pro His				
	195		200	205
Leu Val Glu Ser Leu Pro Gln Ala Leu Arg Glu Ala Ile Gln Leu Ser				
	210		215	220
Tyr Asn Asp Ala Leu Thr Pro Ile Phe Leu Ala Leu Thr Pro Ile Ala				
225		230		235
Val Val Ala Ala Ile Leu Leu Phe Phe Ile Arg Glu Asp His Leu Lys				
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Glu Thr His Glu				
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 Met Thr His Glu Thr  
 1 5  
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 Ser Val Pro Gly Pro Ala Asp Ala Gln Val Ala Gly Asp Thr Lys Leu  
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 cgc aaa ggc cgc gcg aag aag gaa aaa act cct tca tca atg acg cct 211  
 Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro Ser Ser Met Thr Pro  
 25 30 35  
 gaa caa caa aag aaa gtc tgg tgg gtc ctc agc gcg ctg atg gtc gcc 259  
 Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser Ala Leu Met Val Ala  
 40 45 50  
 atg atg atg gcc tcc ctt gac cag atg att ttc ggc aca gcc ctg cca 307

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Thr	Ile	Val	Gly	Glu	Leu	Gly	Gly	Val	Asp	His	Met	Met	Trp	Val	Ile		
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acc	gca	tac	cta	ctt	gcc	gaa	acc	atc	atg	ctg	ccg	atc	tac	gga	aag	403	
Thr	Ala	Tyr	Leu	Leu	Ala	Glu	Thr	Ile	Met	Leu	Pro	Ile	Tyr	Gly	Lys		
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ctc	ggc	gac	ctg	gtt	gga	cgt	aaa	ggc	ctc	ttc	atc	gga	gcc	ctc	ggc	451	
Leu	Gly	Asp	Leu	Val	Gly	Arg	Lys	Gly	Leu	Phe	Ile	Gly	Ala	Leu	Gly		
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atc	ttc	ctg	atc	ggc	tcc	gtc	atc	ggc	ggg	ctt	gca	gga	aat	atg	acc	499	
Ile	Phe	Leu	Ile	Gly	Ser	Val	Ile	Gly	Gly	Leu	Ala	Gly	Asn	Met	Thr		
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Trp	Leu	Ile	Val	Gly	Arg	Ala	Val	Gln	Gly	Ile	Gly	Gly	Gly	Gly	Leu		
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Met	Ile	Leu	Ser	Gln	Ala	Ile	Ile	Ala	Asp	Val	Val	Pro	Ala	Arg	Glu		
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cgt	ggc	cgc	tac	atg	ggc	gtc	atg	ggc	gga	gtc	ttc	gga	ctc	tct	gca	643	
Arg	Gly	Arg	Tyr	Met	Gly	Val	Met	Gly	Gly	Val	Phe	Gly	Leu	Ser	Ala		
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gtt	ctt	ggc	cca	cta	ctc	ggc	ggc	tgg	ttc	acc	gaa	gga	cca	ggc	tgg	691	
Val	Leu	Gly	Pro	Leu	Leu	Gly	Gly	Trp	Phe	Thr	Glu	Gly	Pro	Gly	Trp		
			185					190					195				
cgc	tgg	gca	ttc	tgg	atg	aac	atc	cca	ctg	gga	atc	atc	gcc	atc	ggc	739	
Arg	Trp	Ala	Phe	Trp	Met	Asn	Ile	Pro	Leu	Gly	Ile	Ile	Ala	Ile	Gly		
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gtc	gcc	att	tac	ttc	ctg	gac	att	cca	aag	aag	agc	gtc	aag	ttc	cgc	787	
Val	Ala	Ile	Tyr	Phe	Leu	Asp	Ile	Pro	Lys	Lys	Ser	Val	Lys	Phe	Arg		
	215					220					225						
tgg	gat	tac	ctg	ggc	act	ttc	ttc	atg	atc	gtt	gcc	gca	acc	agc	ctg	835	
Trp	Asp	Tyr	Leu	Gly	Thr	Phe	Phe	Met	Ile	Val	Ala	Ala	Thr	Ser	Leu		
230					235					240					245		
atc	ctg	ttc	acc	acc	tgg	ggc	gga	tcc	cag	tac	gag	tgg	tct	gat	cca	883	
Ile	Leu	Phe	Thr	Thr	Trp	Gly	Gly	Ser	Gln	Tyr	Glu	Trp	Ser	Asp	Pro		
			250					255						260			
atc	atc	att	gga	ctg	atc	atc	acc	acc	atc	gtt	gcc	gct	gca	ctg	ctg	931	
Ile	Ile	Ile	Gly	Leu	Ile	Ile	Thr	Thr	Ile	Val	Ala	Ala	Ala	Leu	Leu		
			265				270						275				
gtt	gtt	gtg	gaa	ctg	cgc	gca	aaa	gat	cca	ttg	gtt	cca	atg	tcc	ttc	979	
Val	Val	Val	Glu	Leu	Arg	Ala	Lys	Asp	Pro	Leu	Val	Pro	Met	Ser	Phe		

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Phe Gln Asn Arg Asn Phe Thr Leu Thr Thr Ile Ala Gly Leu Ile Leu			
295	300	305	
ggt atc gca atg ttc ggc atc atc ggc tac ctt ccg acc tac ctc cag			1075
Gly Ile Ala Met Phe Gly Ile Ile Gly Tyr Leu Pro Thr Tyr Leu Gln			
310	315	320	325
atg gtc cac gga atc aac gcc acc gaa gcc ggc tac atg ctg atc cca			1123
Met Val His Gly Ile Asn Ala Thr Glu Ala Gly Tyr Met Leu Ile Pro			
	330	335	340
atg atg gtc ggc atg atg ggt acc tcc atc tgg act ggt atc cgc atc			1171
Met Met Val Gly Met Met Gly Thr Ser Ile Trp Thr Gly Ile Arg Ile			
	345	350	355
tcc aac aca gga aag tac aaa ctc ttc cca cca atc ggc atg gtg gtt			1219
Ser Asn Thr Gly Lys Tyr Lys Leu Phe Pro Pro Ile Gly Met Val Val			
	360	365	370
acc ttc gtg gca ctg atc ttc ttt gcc cga atg gaa gtg tcc acc acc			1267
Thr Phe Val Ala Leu Ile Phe Phe Ala Arg Met Glu Val Ser Thr Thr			
	375	380	385
ctg tgg cag atc gga atc tac ctc ttc gtc ctc ggc gtc ggc ctg ggt			1315
Leu Trp Gln Ile Gly Ile Tyr Leu Phe Val Leu Gly Val Gly Leu Gly			
390	395	400	405
cta gcc atg cag gtt ctg gtc ctg atc gtt cag aac acc ctg cca acc			1363
Leu Ala Met Gln Val Leu Val Leu Ile Val Gln Asn Thr Leu Pro Thr			
	410	415	420
gcg gtg gtc gga tcc gca acc gct gtg aac aac ttc ttc cgt caa atc			1411
Ala Val Val Gly Ser Ala Thr Ala Val Asn Asn Phe Phe Arg Gln Ile			
	425	430	435
ggt tcc tca ctc gga tcc gcg ctg gtc ggt ggc atg ttc gtt ggc aac			1459
Gly Ser Ser Leu Gly Ser Ala Leu Val Gly Gly Met Phe Val Gly Asn			
	440	445	450
ttg gga acc ctc atg gaa gaa aga atg cca gca gcc atg gca caa ctt			1507
Leu Gly Thr Leu Met Glu Glu Arg Met Pro Ala Ala Met Ala Gln Leu			
	455	460	465
tca cca gaa gaa caa gcc gcc atg gca gcc caa ggc gga ctg gac tcc			1555
Ser Pro Glu Glu Gln Ala Ala Met Ala Ala Gln Gly Gly Leu Asp Ser			
470	475	480	485
aac gaa ttg acg ccg gca atc gtc aat caa ttg cca acc gcg ctc cac			1603
Asn Glu Leu Thr Pro Ala Ile Val Asn Gln Leu Pro Thr Ala Leu His			
	490	495	500
gat gcg ttc gcc ggt tcc tac aac gac gca ctc atc cca gtg ttc tac			1651
Asp Ala Phe Ala Gly Ser Tyr Asn Asp Ala Leu Ile Pro Val Phe Tyr			
	505	510	515

gtg atg atg cca ctg atc ggc atc gcg ctg ctt ctc ttg ctg ttt att 1699  
 Val Met Met Pro Leu Ile Gly Ile Ala Leu Leu Leu Leu Leu Phe Ile  
           520                          525                          530

aag caa gaa aaa cta cgc gaa acc acc aca gac taaacacaaa acaaattgaga 1752  
 Lys Gln Glu Lys Leu Arg Glu Thr Thr Thr Asp  
           535                          540

cct 1755

<210> 254

<211> 544

<212> PRT

<213> Corynebacterium glutamicum

<400> 254

Met Thr His Glu Thr Ser Val Pro Gly Pro Ala Asp Ala Gln Val Ala  
       1                          5                          10                          15

Gly Asp Thr Lys Leu Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro  
                           20                          25                          30

Ser Ser Met Thr Pro Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser  
           35                          40                          45

Ala Leu Met Val Ala Met Met Met Ala Ser Leu Asp Gln Met Ile Phe  
       50                          55                          60

Gly Thr Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asp His  
       65                          70                          75                          80

Met Met Trp Val Ile Thr Ala Tyr Leu Leu Ala Glu Thr Ile Met Leu  
                           85                          90                          95

Pro Ile Tyr Gly Lys Leu Gly Asp Leu Val Gly Arg Lys Gly Leu Phe  
                           100                          105                          110

Ile Gly Ala Leu Gly Ile Phe Leu Ile Gly Ser Val Ile Gly Gly Leu  
           115                          120                          125

Ala Gly Asn Met Thr Trp Leu Ile Val Gly Arg Ala Val Gln Gly Ile  
       130                          135                          140

Gly Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Ile Ala Asp Val  
       145                          150                          155                          160

Val Pro Ala Arg Glu Arg Gly Arg Tyr Met Gly Val Met Gly Gly Val  
                           165                          170                          175

Phe Gly Leu Ser Ala Val Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr  
           180                          185                          190

Glu Gly Pro Gly Trp Arg Trp Ala Phe Trp Met Asn Ile Pro Leu Gly  
           195                          200                          205

Ile Ile Ala Ile Gly Val Ala Ile Tyr Phe Leu Asp Ile Pro Lys Lys  
 210 215 220  
 Ser Val Lys Phe Arg Trp Asp Tyr Leu Gly Thr Phe Phe Met Ile Val  
 225 230 235 240  
 Ala Ala Thr Ser Leu Ile Leu Phe Thr Thr Trp Gly Gly Ser Gln Tyr  
 245 250 255  
 Glu Trp Ser Asp Pro Ile Ile Ile Gly Leu Ile Ile Thr Thr Ile Val  
 260 265 270  
 Ala Ala Ala Leu Leu Val Val Val Glu Leu Arg Ala Lys Asp Pro Leu  
 275 280 285  
 Val Pro Met Ser Phe Phe Gln Asn Arg Asn Phe Thr Leu Thr Thr Ile  
 290 295 300  
 Ala Gly Leu Ile Leu Gly Ile Ala Met Phe Gly Ile Ile Gly Tyr Leu  
 305 310 315 320  
 Pro Thr Tyr Leu Gln Met Val His Gly Ile Asn Ala Thr Glu Ala Gly  
 325 330 335  
 Tyr Met Leu Ile Pro Met Met Val Gly Met Met Gly Thr Ser Ile Trp  
 340 345 350  
 Thr Gly Ile Arg Ile Ser Asn Thr Gly Lys Tyr Lys Leu Phe Pro Pro  
 355 360 365  
 Ile Gly Met Val Val Thr Phe Val Ala Leu Ile Phe Phe Ala Arg Met  
 370 375 380  
 Glu Val Ser Thr Thr Leu Trp Gln Ile Gly Ile Tyr Leu Phe Val Leu  
 385 390 395 400  
 Gly Val Gly Leu Gly Leu Ala Met Gln Val Leu Val Leu Ile Val Gln  
 405 410 415  
 Asn Thr Leu Pro Thr Ala Val Val Gly Ser Ala Thr Ala Val Asn Asn  
 420 425 430  
 Phe Phe Arg Gln Ile Gly Ser Ser Leu Gly Ser Ala Leu Val Gly Gly  
 435 440 445  
 Met Phe Val Gly Asn Leu Gly Thr Leu Met Glu Glu Arg Met Pro Ala  
 450 455 460  
 Ala Met Ala Gln Leu Ser Pro Glu Glu Gln Ala Ala Met Ala Ala Gln  
 465 470 475 480  
 Gly Gly Leu Asp Ser Asn Glu Leu Thr Pro Ala Ile Val Asn Gln Leu  
 485 490 495  
 Pro Thr Ala Leu His Asp Ala Phe Ala Gly Ser Tyr Asn Asp Ala Leu  
 500 505 510



Ile Pro Val Phe Tyr Val Met Met Pro Leu Ile Gly Ile Ala Leu Leu  
 515 520 525

Leu Leu Leu Phe Ile Lys Gln Glu Lys Leu Arg Glu Thr Thr Thr Asp  
 530 535 540

<210> 255

<211> 1294

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(1294)

<223> FRXA01319

<400> 255

ccctgacacc aatcttcttg gcgctcaccc cgatcgagcgt agtcgccgcg atcctcctct 60  
 ttttcatccg tgaagatcac ctcaaggaaa cgcacgaata atg aca cac gaa act 115  
 Met Thr His Glu Thr  
 1 5  
 tcc gtc ccc gga cct gcc gac gcg cag gtc gca gga gat acg aag ctg 163  
 Ser Val Pro Gly Pro Ala Asp Ala Gln Val Ala Gly Asp Thr Lys Leu  
 10 15 20  
 cgc aaa ggc cgc gcg aag aag gaa aaa act cct tca tca atg acg cct 211  
 Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro Ser Ser Met Thr Pro  
 25 30 35  
 gaa caa caa aag aaa gtc tgg tgg gtc ctc agc gcg ctg atg gtc gcc 259  
 Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser Ala Leu Met Val Ala  
 40 45 50  
 atg atg atg gcc tcc ctt gac cag atg att ttc ggc aca gcc ctg cca 307  
 Met Met Met Ala Ser Leu Asp Gln Met Ile Phe Gly Thr Ala Leu Pro  
 55 60 65  
 aca atc gtc ggt gaa ctc ggc ggc gtt gac cac atg atg tgg gtc atc 355  
 Thr Ile Val Gly Glu Leu Gly Gly Val Asp His Met Met Trp Val Ile  
 70 75 80 85  
 acc gca tac cta ctt gcc gaa acc atc atg ctg ccg atc tac gga aag 403  
 Thr Ala Tyr Leu Leu Ala Glu Thr Ile Met Leu Pro Ile Tyr Gly Lys  
 90 95 100  
 ctc ggc gac ctg gtt gga cgt aaa ggt ctc ttc atc gga gcc ctc ggc 451  
 Leu Gly Asp Leu Val Gly Arg Lys Gly Leu Phe Ile Gly Ala Leu Gly  
 105 110 115  
 atc ttc ctg atc ggc tcc gtc atc ggc ggg ctt gca gga aat atg acc 499  
 Ile Phe Leu Ile Gly Ser Val Ile Gly Gly Leu Ala Gly Asn Met Thr

120	125	130	
tgg ttg atc gtc ggc cgt gcc gta cag ggc atc ggt ggc ggt gga ctg Trp Leu Ile Val Gly Arg Ala Val Gln Gly Ile Gly Gly Gly Gly Leu 135 140 145			547
atg atc ctc tcg cag gca atc atc gcg gac gtt gtt cca gca cgt gaa Met Ile Leu Ser Gln Ala Ile Ile Ala Asp Val Val Pro Ala Arg Glu 150 155 160 165			595
cgt ggc cgc tac atg ggt gtc atg ggt gga gtc ttc gga ctc tct gca Arg Gly Arg Tyr Met Gly Val Met Gly Gly Val Phe Gly Leu Ser Ala 170 175 180			643
gtt ctt ggc cca cta ctc ggt ggc tgg ttc acc gaa gga cca ggc tgg Val Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr Glu Gly Pro Gly Trp 185 190 195			691
cgc tgg gca ttc tgg atg aac atc cca ctg gga atc atc gcc atc ggt Arg Trp Ala Phe Trp Met Asn Ile Pro Leu Gly Ile Ile Ala Ile Gly 200 205 210			739
gtc gcc att tac ttc ctg gac att cca aag aag agc gtc aag ttc cgc Val Ala Ile Tyr Phe Leu Asp Ile Pro Lys Lys Ser Val Lys Phe Arg 215 220 225			787
tgg gat tac ctg ggc act ttc ttc atg atc gtt gcc gca acc agc ctg Trp Asp Tyr Leu Gly Thr Phe Phe Met Ile Val Ala Ala Thr Ser Leu 230 235 240 245			835
atc ctg ttc acc acc tgg ggt gga tcc cag tac gag tgg tct gat cca Ile Leu Phe Thr Thr Trp Gly Gly Ser Gln Tyr Glu Trp Ser Asp Pro 250 255 260			883
atc atc att gga ctg atc atc acc acc atc gtt gcc gct gca ctg ctg Ile Ile Ile Gly Leu Ile Ile Thr Thr Ile Val Ala Ala Ala Leu Leu 265 270 275			931
gtt gtt gtg gaa ctg cgc gca aaa gat cca ttg gtt cca atg tcc ttc Val Val Val Glu Leu Arg Ala Lys Asp Pro Leu Val Pro Met Ser Phe 280 285 290			979
ttc caa aac cgc aac ttc acg ctc acc acc att gca ggc ctg atc ctg Phe Gln Asn Arg Asn Phe Thr Leu Thr Thr Ile Ala Gly Leu Ile Leu 295 300 305			1027
ggt atc gca atg ttc ggc atc atc ggc tac ctt ccg acc tac ctc cag Gly Ile Ala Met Phe Gly Ile Ile Gly Tyr Leu Pro Thr Tyr Leu Gln 310 315 320 325			1075
atg gtc cac gga atc aac gcc acc gaa gcc ggc tac atg ctg atc cca Met Val His Gly Ile Asn Ala Thr Glu Ala Gly Tyr Met Leu Ile Pro 330 335 340			1123
atg atg gtc ggc atg atg ggt acc tcc atc tgg act ggt atc cgc atc Met Met Val Gly Met Met Gly Thr Ser Ile Trp Thr Gly Ile Arg Ile 345 350 355			1171

tcc aac aca gga aag tac aaa ctc ttc cca cca atc ggc atg gtg gtt 1219  
 Ser Asn Thr Gly Lys Tyr Lys Leu Phe Pro Pro Ile Gly Met Val Val  
           360                          365                          370

acc ttc gtg gca ctg atc ttc ttt gcc cga atg gaa gtg tcc acc acc 1267  
 Thr Phe Val Ala Leu Ile Phe Phe Ala Arg Met Glu Val Ser Thr Thr  
           375                          380                          385

ctg tgg cag atc gga atc tac ctc ttc 1294  
 Leu Trp Gln Ile Gly Ile Tyr Leu Phe  
           390                          395

<210> 256

<211> 398

<212> PRT

<213> Corynebacterium glutamicum

<400> 256

Met Thr His Glu Thr Ser Val Pro Gly Pro Ala Asp Ala Gln Val Ala  
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Gly Asp Thr Lys Leu Arg Lys Gly Arg Ala Lys Lys Glu Lys Thr Pro  
                           20                          25                          30

Ser Ser Met Thr Pro Glu Gln Gln Lys Lys Val Trp Trp Val Leu Ser  
           35                          40                          45

Ala Leu Met Val Ala Met Met Met Ala Ser Leu Asp Gln Met Ile Phe  
           50                          55                          60

Gly Thr Ala Leu Pro Thr Ile Val Gly Glu Leu Gly Gly Val Asp His  
       65                          70                          75                          80

Met Met Trp Val Ile Thr Ala Tyr Leu Leu Ala Glu Thr Ile Met Leu  
                           85                          90                          95

Pro Ile Tyr Gly Lys Leu Gly Asp Leu Val Gly Arg Lys Gly Leu Phe  
                           100                          105                          110

Ile Gly Ala Leu Gly Ile Phe Leu Ile Gly Ser Val Ile Gly Gly Leu  
           115                          120                          125

Ala Gly Asn Met Thr Trp Leu Ile Val Gly Arg Ala Val Gln Gly Ile  
       130                          135                          140

Gly Gly Gly Gly Leu Met Ile Leu Ser Gln Ala Ile Ile Ala Asp Val  
       145                          150                          155                          160

Val Pro Ala Arg Glu Arg Gly Arg Tyr Met Gly Val Met Gly Gly Val  
                           165                          170                          175

Phe Gly Leu Ser Ala Val Leu Gly Pro Leu Leu Gly Gly Trp Phe Thr  
                           180                          185                          190

Glu Gly Pro Gly Trp Arg Trp Ala Phe Trp Met Asn Ile Pro Leu Gly

195	200	205
Ile Ile Ala Ile Gly Val	Ala Ile Tyr Phe Leu	Asp Ile Pro Lys Lys
210	215	220
Ser Val Lys Phe Arg Trp	Asp Tyr Leu Gly Thr	Phe Phe Met Ile Val
225	230	235 240
Ala Ala Thr Ser Leu Ile	Leu Phe Thr Thr Trp	Gly Gly Ser Gln Tyr
245	250	255
Glu Trp Ser Asp Pro Ile	Ile Ile Gly Leu Ile	Ile Thr Thr Ile Val
260	265	270
Ala Ala Ala Leu Leu Val	Val Val Glu Leu Arg	Ala Lys Asp Pro Leu
275	280	285
Val Pro Met Ser Phe Phe	Gln Asn Arg Asn Phe	Thr Leu Thr Thr Ile
290	295	300
Ala Gly Leu Ile Leu Gly	Ile Ala Met Phe Gly	Ile Ile Gly Tyr Leu
305	310	315 320
Pro Thr Tyr Leu Gln Met	Val His Gly Ile Asn	Ala Thr Glu Ala Gly
325	330	335
Tyr Met Leu Ile Pro Met	Met Val Gly Met Met	Gly Thr Ser Ile Trp
340	345	350
Thr Gly Ile Arg Ile Ser	Asn Thr Gly Lys Tyr	Lys Leu Phe Pro Pro
355	360	365
Ile Gly Met Val Val Thr	Phe Val Ala Leu Ile	Phe Phe Ala Arg Met
370	375	380
Glu Val Ser Thr Thr Leu	Trp Gln Ile Gly Ile	Tyr Leu Phe
385	390	395

<210> 257  
 <211> 1510  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (93)..(1487)  
 <223> RXA01578

<400> 257  
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 gtaaaacctc ggccgccaca gtcataccat tgatg atc gcc ctg ctg gtc gcg 113  
 Met Ile Ala Leu Leu Val Ala  
 1 5  
 gta ttc gcc ttc cag ctc aac gcc tcc atg ctg gcg ccg gca ctg gcc 161

Val	Phe	Ala	Phe	Gln	Leu	Asn	Ala	Ser	Met	Leu	Ala	Pro	Ala	Leu	Ala		
		10					15					20					
acc	atg	gaa	act	gaa	ctt	aat	gca	aca	gct	gcc	caa	atc	ggc	atg	acg	209	
Thr	Met	Glu	Thr	Glu	Leu	Asn	Ala	Thr	Ala	Ala	Gln	Ile	Gly	Met	Thr		
		25				30					35						
cag	act	gct	ttc	ttc	acc	gcg	gcg	gcg	ctg	ttt	tcc	ctg	ttc	ctg	cca	257	
Gln	Thr	Ala	Phe	Phe	Thr	Ala	Ala	Ala	Leu	Phe	Ser	Leu	Phe	Leu	Pro		
		40			45					50					55		
cgt	tgg	ggc	gat	ctg	att	ggc	cgc	cgc	aaa	gtg	ctg	gtc	ggc	atg	atg	305	
Arg	Trp	Gly	Asp	Leu	Ile	Gly	Arg	Arg	Lys	Val	Leu	Val	Gly	Met	Met		
				60					65					70			
att	gtc	acc	ggc	att	gga	tgt	gtt	gtc	gct	gcc	ttt	gct	ccg	aat	gtg	353	
Ile	Val	Thr	Gly	Ile	Gly	Cys	Val	Val	Ala	Ala	Phe	Ala	Pro	Asn	Val		
			75					80					85				
acc	atc	ctc	ttc	ctg	ggc	cgc	ctg	att	caa	ggc	gtt	gct	ggc	cca	acc	401	
Thr	Ile	Leu	Phe	Leu	Gly	Arg	Leu	Ile	Gln	Gly	Val	Ala	Gly	Pro	Thr		
		90					95					100					
gtg	cca	ctg	tgt	ctg	atc	att	ctg	cgc	cag	cag	gta	acc	aat	gaa	aag	449	
Val	Pro	Leu	Cys	Leu	Ile	Ile	Leu	Arg	Gln	Gln	Val	Thr	Asn	Glu	Lys		
	105						110				115						
caa	tat	gcg	cta	ctt	ctc	gga	att	gtt	acc	tct	gtc	aac	ggc	ggc	atc	497	
Gln	Tyr	Ala	Leu	Leu	Leu	Gly	Ile	Val	Thr	Ser	Val	Asn	Gly	Gly	Ile		
	120				125				130						135		
ggc	ggc	gtg	gac	gcg	ctt	gct	ggc	ggc	tgg	ttg	gct	gaa	aca	ctt	ggc	545	
Gly	Gly	Val	Asp	Ala	Leu	Ala	Gly	Gly	Trp	Leu	Ala	Glu	Thr	Leu	Gly		
			140					145						150			
ttc	cgt	tcc	atc	ttc	tgg	gtc	atg	gct	gct	ttc	tgc	gct	gtc	gct	gcc	593	
Phe	Arg	Ser	Ile	Phe	Trp	Val	Met	Ala	Ala	Phe	Cys	Ala	Val	Ala	Ala		
			155				160						165				
ctc	gca	ctg	cct	ttc	agc	gtg	aag	gaa	tcc	acc	gct	gaa	gaa	acc	ccg	641	
Leu	Ala	Leu	Pro	Phe	Ser	Val	Lys	Glu	Ser	Thr	Ala	Glu	Glu	Thr	Pro		
		170					175					180					
aag	atg	gac	tgg	ctt	ggc	gtg	ctg	cca	ctg	gcg	gtg	tcc	att	gga	tct	689	
Lys	Met	Asp	Trp	Leu	Gly	Val	Leu	Pro	Leu	Ala	Val	Ser	Ile	Gly	Ser		
	185					190					195						
ttg	ctc	atg	gct	ttc	aac	gag	gcc	ggc	aaa	ctc	ggc	gcc	gcg	aac	tgg	737	
Leu	Leu	Met	Ala	Phe	Asn	Glu	Ala	Gly	Lys	Leu	Gly	Ala	Ala	Asn	Trp		
	200				205					210					215		
att	ctg	gtg	gtt	gtg	ctg	ttc	atc	atc	ggc	atc	gcc	gga	gtc	atc	ttc	785	
Ile	Leu	Val	Val	Val	Leu	Phe	Ile	Ile	Gly	Ile	Ala	Gly	Val	Ile	Phe		
				220					225					230			
ttc	tac	aac	att	gaa	aag	cgc	gtt	aag	cac	ccg	ctg	gtc	agt	gtt	gaa	833	
Phe	Tyr	Asn	Ile	Glu	Lys	Arg	Val	Lys	His	Pro	Leu	Val	Ser	Val	Glu		

235	240	245	
tac ctc ggt caa cga cgc acc tgg gca ttg ctg ctg agc acc ctt ctc			881
Tyr Leu Gly Gln Arg Arg Thr Trp Ala Leu Leu Leu Ser Thr Leu Leu			
250	255	260	
aca atg acc ggt gta ttc gcc gta atg aat ggt ctg ctg ccc aac ctt			929
Thr Met Thr Gly Val Phe Ala Val Met Asn Gly Leu Leu Pro Asn Leu			
265	270	275	
gcg cag gat gct gcc aac ggt gcc ggc atg tca gcg agc gtg gtg tcc			977
Ala Gln Asp Ala Ala Asn Gly Ala Gly Met Ser Ala Ser Val Val Ser			
280	285	290	295
tgg tgg aca ctt acc cca tat gcg ctg gct ggc ttg gta ttc ggt cca			1025
Trp Trp Thr Leu Thr Pro Tyr Ala Leu Ala Gly Leu Val Phe Gly Pro			
300	305	310	
atc gcc gga att ctc gcc gga aaa ttt gga tac aag atc gtc ctg caa			1073
Ile Ala Gly Ile Leu Ala Gly Lys Phe Gly Tyr Lys Ile Val Leu Gln			
315	320	325	
att ggt atc gct gcc acc atc atc ggc gtt gcc gga gcc acc ttc tta			1121
Ile Gly Ile Ala Ala Thr Ile Ile Gly Val Ala Gly Ala Thr Phe Leu			
330	335	340	
gtc gga agc acc tcg cat ctc gcg tac ctc ggc atc tcc atc ttc gtg			1169
Val Gly Ser Thr Ser His Leu Ala Tyr Leu Gly Ile Ser Ile Phe Val			
345	350	355	
ggt att acc tat gca ggt att gcc aac atc atg ctc aac ggc ctg ggc			1217
Gly Ile Thr Tyr Ala Gly Ile Ala Asn Ile Met Leu Asn Gly Leu Gly			
360	365	370	375
atc gtg ctc tcc cct gct aac aac caa ggc tat ctg cct ggc atg aac			1265
Ile Val Leu Ser Pro Ala Asn Asn Gln Gly Tyr Leu Pro Gly Met Asn			
380	385	390	
gca ggt gcc ttc aac cta ggt gca ggt att tcc ttc gcc atc ctc ttc			1313
Ala Gly Ala Phe Asn Leu Gly Ala Gly Ile Ser Phe Ala Ile Leu Phe			
395	400	405	
gca gtt tcc acg gca ttc agt gac aac ggc gga gga tac gcc gca ggc			1361
Ala Val Ser Thr Ala Phe Ser Asp Asn Gly Gly Gly Tyr Ala Ala Gly			
410	415	420	
atg tgg gct ggc gtg atc atc ttg gtc cta gcc ttc ctc tgc tcc ctg			1409
Met Trp Ala Gly Val Ile Ile Leu Val Leu Ala Phe Leu Cys Ser Leu			
425	430	435	
ctg atc cca cgc cca gaa tca atc acc gat aca gtg gca gcc aaa gtc			1457
Leu Ile Pro Arg Pro Glu Ser Ile Thr Asp Thr Val Ala Ala Lys Val			
440	445	450	455
cag gct gaa gaa gcc gct caa gcc gcc agc taaatccaca aactgaacta			1507
Gln Ala Glu Glu Ala Ala Gln Ala Ala Ser			
460	465		

agg

1510

&lt;210&gt; 258

&lt;211&gt; 465

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 258

Met Ile Ala Leu Leu Val Ala Val Phe Ala Phe Gln Leu Asn Ala Ser  
 1 5 10 15

Met Leu Ala Pro Ala Leu Ala Thr Met Glu Thr Glu Leu Asn Ala Thr  
 20 25 30

Ala Ala Gln Ile Gly Met Thr Gln Thr Ala Phe Phe Thr Ala Ala Ala  
 35 40 45

Leu Phe Ser Leu Phe Leu Pro Arg Trp Gly Asp Leu Ile Gly Arg Arg  
 50 55 60

Lys Val Leu Val Gly Met Met Ile Val Thr Gly Ile Gly Cys Val Val  
 65 70 75 80

Ala Ala Phe Ala Pro Asn Val Thr Ile Leu Phe Leu Gly Arg Leu Ile  
 85 90 95

Gln Gly Val Ala Gly Pro Thr Val Pro Leu Cys Leu Ile Ile Leu Arg  
 100 105 110

Gln Gln Val Thr Asn Glu Lys Gln Tyr Ala Leu Leu Leu Gly Ile Val  
 115 120 125

Thr Ser Val Asn Gly Gly Ile Gly Gly Val Asp Ala Leu Ala Gly Gly  
 130 135 140

Trp Leu Ala Glu Thr Leu Gly Phe Arg Ser Ile Phe Trp Val Met Ala  
 145 150 155 160

Ala Phe Cys Ala Val Ala Ala Leu Ala Leu Pro Phe Ser Val Lys Glu  
 165 170 175

Ser Thr Ala Glu Glu Thr Pro Lys Met Asp Trp Leu Gly Val Leu Pro  
 180 185 190

Leu Ala Val Ser Ile Gly Ser Leu Leu Met Ala Phe Asn Glu Ala Gly  
 195 200 205

Lys Leu Gly Ala Ala Asn Trp Ile Leu Val Val Val Leu Phe Ile Ile  
 210 215 220

Gly Ile Ala Gly Val Ile Phe Phe Tyr Asn Ile Glu Lys Arg Val Lys  
 225 230 235 240

His Pro Leu Val Ser Val Glu Tyr Leu Gly Gln Arg Arg Thr Trp Ala  
 245 250 255



Leu Leu Leu Ser Thr Leu Leu Thr Met Thr Gly Val Phe Ala Val Met  
260 265 270

Asn Gly Leu Leu Pro Asn Leu Ala Gln Asp Ala Ala Asn Gly Ala Gly  
275 280 285

Met Ser Ala Ser Val Val Ser Trp Trp Thr Leu Thr Pro Tyr Ala Leu  
290 295 300

Ala Gly Leu Val Phe Gly Pro Ile Ala Gly Ile Leu Ala Gly Lys Phe  
305 310 315 320

Gly Tyr Lys Ile Val Leu Gln Ile Gly Ile Ala Ala Thr Ile Ile Gly  
325 330 335

Val Ala Gly Ala Thr Phe Leu Val Gly Ser Thr Ser His Leu Ala Tyr  
340 345 350

Leu Gly Ile Ser Ile Phe Val Gly Ile Thr Tyr Ala Gly Ile Ala Asn  
355 360 365

Ile Met Leu Asn Gly Leu Gly Ile Val Leu Ser Pro Ala Asn Asn Gln  
370 375 380

Gly Tyr Leu Pro Gly Met Asn Ala Gly Ala Phe Asn Leu Gly Ala Gly  
385 390 395 400

Ile Ser Phe Ala Ile Leu Phe Ala Val Ser Thr Ala Phe Ser Asp Asn  
405 410 415

Gly Gly Gly Tyr Ala Ala Gly Met Trp Ala Gly Val Ile Ile Leu Val  
420 425 430

Leu Ala Phe Leu Cys Ser Leu Leu Ile Pro Arg Pro Glu Ser Ile Thr  
435 440 445

Asp Thr Val Ala Ala Lys Val Gln Ala Glu Glu Ala Ala Gln Ala Ala  
450 455 460

Ser  
465

<210> 259  
<211> 1470  
<212> DNA  
<213> *Corynebacterium glutamicum*

<220>  
<221> CDS  
<222> (101)..(1447)  
<223> RXA02087

<400> 259  
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357

Ala	Leu	Gln	Gln	Gly	Pro	Glu	Leu	Gly	Trp	Gly	Thr	Leu	Ile	Trp	Val		
215						220					225						
tcc	ctt	gcc	gtt	ggt	att	gct	gca	gct	gtg	ctc	ttt	ata	tgg	atg	caa	835	
Ser	Leu	Ala	Val	Gly	Ile	Ala	Ala	Ala	Val	Leu	Phe	Ile	Trp	Met	Gln		
230					235					240					245		
aca	aga	tcc	aag	gcg	cca	ctg	atg	ccg	ttg	agg	att	ttc	aag	acg	cgc	883	
Thr	Arg	Ser	Lys	Ala	Pro	Leu	Met	Pro	Leu	Arg	Ile	Phe	Lys	Thr	Arg		
				250					255					260			
aac	ttc	gcg	atc	ggt	gca	ttt	tcg	atc	ttc	agc	ctg	ggc	ttt	acg	gtg	931	
Asn	Phe	Ala	Ile	Gly	Ala	Phe	Ser	Ile	Phe	Ser	Leu	Gly	Phe	Thr	Val		
			265					270					275				
tat	tcc	gtt	aat	ttg	ccc	atc	atg	ttg	tat	ctg	caa	acg	gct	cag	gga	979	
Tyr	Ser	Val	Asn	Leu	Pro	Ile	Met	Leu	Tyr	Leu	Gln	Thr	Ala	Gln	Gly		
		280					285					290					
atg	tcg	tcg	cag	ttg	gcc	ggt	ttg	atg	ttg	gtt	ccg	atg	ggc	atc	atc	1027	
Met	Ser	Ser	Gln	Leu	Ala	Gly	Leu	Met	Leu	Val	Pro	Met	Gly	Ile	Ile		
						300					305						
tct	gtg	gtg	atg	tca	cca	gta	att	gga	cga	ttg	gtg	gat	cgc	ctg	gca	1075	
Ser	Val	Val	Met	Ser	Pro	Val	Ile	Gly	Arg	Leu	Val	Asp	Arg	Leu	Ala		
310						315					320				325		
cca	gga	atg	atc	tcc	aag	atc	gga	ttc	ggc	gcg	ctg	att	ttc	tcg	atg	1123	
Pro	Gly	Met	Ile	Ser	Lys	Ile	Gly	Phe	Gly	Ala	Leu	Ile	Phe	Ser	Met		
				330					335					340			
gcg	ttg	atg	gct	gtc	ttt	atg	atc	gcc	aac	cta	tcg	ccg	tgg	tgg	cta	1171	
Ala	Leu	Met	Ala	Val	Phe	Met	Ile	Ala	Asn	Leu	Ser	Pro	Trp	Trp	Leu		
			345					350					355				
ctc	atc	ccg	att	att	ttg	ttc	ggt	agc	tcc	aac	gcg	atg	agt	ttt	gca	1219	
Leu	Ile	Pro	Ile	Ile	Leu	Phe	Gly	Ser	Ser	Asn	Ala	Met	Ser	Phe	Ala		
		360					365					370					
ccg	aac	tct	gtg	att	gct	ctg	cgt	gat	gtt	ccg	cag	gat	tta	gtg	ggc	1267	
Pro	Asn	Ser	Val	Ile	Ala	Leu	Arg	Asp	Val	Pro	Gln	Asp	Leu	Val	Gly		
						380					385						
tct	gct	tct	ggt	ttt	tac	aac	acc	tca	cgc	cag	gtg	ggc	gct	gtt	ttg	1315	
Ser	Ala	Ser	Gly	Phe	Tyr	Asn	Thr	Ser	Arg	Gln	Val	Gly	Ala	Val	Leu		
390					395					400					405		
ggc	gcc	gct	acc	ttg	ggc	gct	gtg	atg	caa	ata	gga	gtg	ggc	acg	gtg	1363	
Gly	Ala	Ala	Thr	Leu	Gly	Ala	Val	Met	Gln	Ile	Gly	Val	Gly	Thr	Val		
				410					415					420			
tcc	ttc	ggt	gtt	gcc	atg	ggt	gcg	gca	atc	ctg	gtg	aca	ctc	gtg	ccc	1411	
Ser	Phe	Gly	Val	Ala	Met	Gly	Ala	Ala	Ile	Leu	Val	Thr	Leu	Val	Pro		
			425					430					435				
tta	atc	ttt	ggg	ttc	cta	gcg	gta	acc	caa	ttt	aga	tag	ttg	ctcc		1457	
Leu	Ile	Phe	Gly	Phe	Leu	Ala	Val	Thr	Gln	Phe	Arg						

440

445

gatttttctca cga

1470

&lt;210&gt; 260

&lt;211&gt; 449

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 260

Met Thr Pro Ile Val Glu Ser Arg Ala Trp Lys Ala Leu Gly Ala Leu  
 1 5 10 15

Ser Val Gly Leu Phe Leu Thr Leu Leu Asp Gln Ser Leu Val Ala Val  
 20 25 30

Ala Leu Pro Lys Ile Gln Glu Asp Leu Gly Ala Ser Leu Asn Gln Ala  
 35 40 45

Val Trp Val Ser Ala Val Tyr Leu Leu Thr Phe Ala Val Pro Leu Leu  
 50 55 60

Ile Thr Gly Arg Leu Gly Asp Arg Tyr Gly Gln Arg Asn Ile Tyr Leu  
 65 70 75 80

Ala Gly Met Ala Val Phe Thr Leu Ala Ala Leu Ala Cys Val Phe Ala  
 85 90 95

Pro Ser Ile Glu Trp Leu Ile Ala Ala Arg Ala Val Gln Gly Leu Gly  
 100 105 110

Gly Ser Leu Leu Asn Pro Gln Pro Leu Ser Ile Ile His Lys Ile Phe  
 115 120 125

Ala His Asp Arg Arg Gly Ala Ala Thr Gly Val Trp Ser Ala Val Ala  
 130 135 140

Ser Ser Ala Gly Leu Phe Gly Pro Val Ile Gly Gly Val Leu Val Gly  
 145 150 155 160

Trp Ile Ser Trp Arg Ala Val Phe Leu Val Tyr Val Pro Leu Gly Leu  
 165 170 175

Ile Ser Leu Phe Met Val Ala Arg Tyr Val Pro Lys Leu Pro Thr Gly  
 180 185 190

Thr Ser Lys Ile Asp Trp Leu Ser Gly Ala Val Ser Leu Val Ala Val  
 195 200 205

Leu Gly Val Val Leu Ala Leu Gln Gln Gly Pro Glu Leu Gly Trp Gly  
 210 215 220

Thr Leu Ile Trp Val Ser Leu Ala Val Gly Ile Ala Ala Ala Val Leu  
 225 230 235 240

Phe Ile Trp Met Gln Thr Arg Ser Lys Ala Pro Leu Met Pro Leu Arg

245										250					255				
Ile	Phe	Lys	Thr	Arg	Asn	Phe	Ala	Ile	Gly	Ala	Phe	Ser	Ile	Phe	Ser				
			260					265					270						
Leu	Gly	Phe	Thr	Val	Tyr	Ser	Val	Asn	Leu	Pro	Ile	Met	Leu	Tyr	Leu				
		275					280					285							
Gln	Thr	Ala	Gln	Gly	Met	Ser	Ser	Gln	Leu	Ala	Gly	Leu	Met	Leu	Val				
	290					295					300								
Pro	Met	Gly	Ile	Ile	Ser	Val	Val	Met	Ser	Pro	Val	Ile	Gly	Arg	Leu				
305					310					315					320				
Val	Asp	Arg	Leu	Ala	Pro	Gly	Met	Ile	Ser	Lys	Ile	Gly	Phe	Gly	Ala				
				325					330					335					
Leu	Ile	Phe	Ser	Met	Ala	Leu	Met	Ala	Val	Phe	Met	Ile	Ala	Asn	Leu				
			340					345					350						
Ser	Pro	Trp	Trp	Leu	Leu	Ile	Pro	Ile	Ile	Leu	Phe	Gly	Ser	Ser	Asn				
		355					360					365							
Ala	Met	Ser	Phe	Ala	Pro	Asn	Ser	Val	Ile	Ala	Leu	Arg	Asp	Val	Pro				
	370					375					380								
Gln	Asp	Leu	Val	Gly	Ser	Ala	Ser	Gly	Phe	Tyr	Asn	Thr	Ser	Arg	Gln				
385					390					395					400				
Val	Gly	Ala	Val	Leu	Gly	Ala	Ala	Thr	Leu	Gly	Ala	Val	Met	Gln	Ile				
				405					410					415					
Gly	Val	Gly	Thr	Val	Ser	Phe	Gly	Val	Ala	Met	Gly	Ala	Ala	Ile	Leu				
			420					425					430						
Val	Thr	Leu	Val	Pro	Leu	Ile	Phe	Gly	Phe	Leu	Ala	Val	Thr	Gln	Phe				
		435					440					445							

Arg

<210> 261  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1315)  
 <223> RXA02088

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 ctagatataa aaggggcgca gggctagcct tgggtgtgaa atg tta act caa aaa 115  
 Met Leu Thr Gln Lys

															1	5	
ata gaa tta gag gct aaa cca aaa atc cca gag gag atc tgg gtg ctg	163																
Ile Glu Leu Glu Ala Lys Pro Lys Ile Pro Glu Glu Ile Trp Val Leu																	
10 15 20																	
gtt gtg gct gcg ttt att att gcg ctg ggc tat ggc ctg att gcg ccg	211																
Val Val Ala Ala Phe Ile Ile Ala Leu Gly Tyr Gly Leu Ile Ala Pro																	
25 30 35																	
att ttg cca cag ttt gtg gtc ggt ttt gat gta agt ttt gca gct gcc	259																
Ile Leu Pro Gln Phe Val Val Gly Phe Asp Val Ser Phe Ala Ala Ala																	
40 45 50																	
agt gcg gtg gtg tcc atc ttt gcg ggc gcc cgg ttg ttg ttt gcg ccg	307																
Ser Ala Val Val Ser Ile Phe Ala Gly Ala Arg Leu Leu Phe Ala Pro																	
55 60 65																	
atg tcg ggg agt ttg atc gat aag atc ggt tcc cgt cgt gtg tat ctc	355																
Met Ser Gly Ser Leu Ile Asp Lys Ile Gly Ser Arg Arg Val Tyr Leu																	
70 75 80 85																	
act ggt tta ctc acc gtg gct atc acc acg ggg ctt gtt gcg ttg gcg	403																
Thr Gly Leu Leu Thr Val Ala Ile Thr Thr Gly Leu Val Ala Leu Ala																	
90 95 100																	
cag gaa tac tgg cag att ctg ctg ctt cgt ggc atc gca ggt att ggt	451																
Gln Glu Tyr Trp Gln Ile Leu Leu Leu Arg Gly Ile Ala Gly Ile Gly																	
105 110 115																	
tcc acc atg ttt acg gtc tct gcc atg ggc ctg atc gtg aag atg gcg	499																
Ser Thr Met Phe Thr Val Ser Ala Met Gly Leu Ile Val Lys Met Ala																	
120 125 130																	
ccg gtg gag atc cgc ggg cgg tgt tcg tcg gta tat gcc agt tcg ttc	547																
Pro Val Glu Ile Arg Gly Arg Cys Ser Ser Val Tyr Ala Ser Ser Phe																	
135 140 145																	
ctg ttt ggc aat att att ggc ccg gtt gtg ggt gct gcg atg tcc ggt	595																
Leu Phe Gly Asn Ile Ile Gly Pro Val Val Gly Ala Ala Met Ser Gly																	
150 155 160 165																	
ttg ggc atg cgg tgg ccg ttc gcg att tat ggt gct tcc gtt ggc tta	643																
Leu Gly Met Arg Trp Pro Phe Ala Ile Tyr Gly Ala Ser Val Gly Leu																	
170 175 180																	
gct gca ctt gtt gtg tgg tgg cgg atg ccg aaa acc aac gat tca ctt	691																
Ala Ala Leu Val Val Trp Trp Arg Met Pro Lys Thr Asn Asp Ser Leu																	
185 190 195																	
cgg aag gct gat agc aat agt gtg ccg gcg ttg cgc ttt gct gag gca	739																
Arg Lys Ala Asp Ser Asn Ser Val Pro Ala Leu Arg Phe Ala Glu Ala																	
200 205 210																	
att aag gat tct gcc tac cgc tcg gcg ttg ttt agt gct ttt gcc aat	787																
Ile Lys Asp Ser Ala Tyr Arg Ser Ala Leu Phe Ser Ala Phe Ala Asn																	
215 220 225																	

ggt tgg tcg aac ttt ggt gtg cgt gtg gcg gtt ctt cca ctg ttt gcc 835  
 Gly Trp Ser Asn Phe Gly Val Arg Val Ala Val Leu Pro Leu Phe Ala  
 230 235 240 245  
 gca gct gca ttt agc aat ggc gga gct att gcg ggt ttt gcc atg gct 883  
 Ala Ala Ala Phe Ser Asn Gly Gly Ala Ile Ala Gly Phe Ala Met Ala  
 250 255 260  
 gcg ttc gcc gct gga aat gct ttg tgt ctg caa ttc gcg ggc gat ctc 931  
 Ala Phe Ala Ala Gly Asn Ala Leu Cys Leu Gln Phe Ala Gly Asp Leu  
 265 270 275  
 tca gat cgc att ggc cgt aaa ccg atg att att tcc ggg ctg atc gtc 979  
 Ser Asp Arg Ile Gly Arg Lys Pro Met Ile Ile Ser Gly Leu Ile Val  
 280 285 290  
 aat gca gtg ttc acg gca atg atc gga ttc ggc aca gaa gtg tgg atc 1027  
 Asn Ala Val Phe Thr Ala Met Ile Gly Phe Gly Thr Glu Val Trp Ile  
 295 300 305  
 ctg atc acg gta tct gcg ttg gca ggt gct ggt gcg ggc ttg ctt aat 1075  
 Leu Ile Thr Val Ser Ala Leu Ala Gly Ala Gly Ala Gly Leu Leu Asn  
 310 315 320 325  
 cca agt cag cag gcg gtg ctc gct gat gtt ata gat tcc cgc ccc ggc 1123  
 Pro Ser Gln Gln Ala Val Leu Ala Asp Val Ile Asp Ser Arg Pro Gly  
 330 335 340  
 gga aaa gtc tta gcg aat ttc caa atg gcg cag gat ttc ggt gcg att 1171  
 Gly Lys Val Leu Ala Asn Phe Gln Met Ala Gln Asp Phe Gly Ala Ile  
 345 350 355  
 gtt ggc ccg att ctc gta ggc atg atc gca gaa cag gca ggc ttc caa 1219  
 Val Gly Pro Ile Leu Val Gly Met Ile Ala Glu Gln Ala Gly Phe Gln  
 360 365 370  
 atc gga ttc atg ctg tgt ggt gtg atc agt ttg ctg gct gcg gtc gca 1267  
 Ile Gly Phe Met Leu Cys Gly Val Ile Ser Leu Leu Ala Ala Val Ala  
 375 380 385  
 tgg atc ttc ggc cgg gag acg ctg cca acg gcg aaa gtc gag cag gta 1315  
 Trp Ile Phe Gly Arg Glu Thr Leu Pro Thr Ala Lys Val Glu Gln Val  
 390 395 400 405  
 taaatgacgc caattgtgga gtc 1338

&lt;210&gt; 262

&lt;211&gt; 405

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 262

Met Leu Thr Gln Lys Ile Glu Leu Glu Ala Lys Pro Lys Ile Pro Glu  
 1 5 10 15



Glu Ile Trp Val Leu Val Val Ala Ala Phe Ile Ile Ala Leu Gly Tyr  
 20 25 30  
 Gly Leu Ile Ala Pro Ile Leu Pro Gln Phe Val Val Gly Phe Asp Val  
 35 40 45  
 Ser Phe Ala Ala Ala Ser Ala Val Val Ser Ile Phe Ala Gly Ala Arg  
 50 55 60  
 Leu Leu Phe Ala Pro Met Ser Gly Ser Leu Ile Asp Lys Ile Gly Ser  
 65 70 75 80  
 Arg Arg Val Tyr Leu Thr Gly Leu Leu Thr Val Ala Ile Thr Thr Gly  
 85 90 95  
 Leu Val Ala Leu Ala Gln Glu Tyr Trp Gln Ile Leu Leu Leu Arg Gly  
 100 105 110  
 Ile Ala Gly Ile Gly Ser Thr Met Phe Thr Val Ser Ala Met Gly Leu  
 115 120 125  
 Ile Val Lys Met Ala Pro Val Glu Ile Arg Gly Arg Cys Ser Ser Val  
 130 135 140  
 Tyr Ala Ser Ser Phe Leu Phe Gly Asn Ile Ile Gly Pro Val Val Gly  
 145 150 155 160  
 Ala Ala Met Ser Gly Leu Gly Met Arg Trp Pro Phe Ala Ile Tyr Gly  
 165 170 175  
 Ala Ser Val Gly Leu Ala Ala Leu Val Val Trp Trp Arg Met Pro Lys  
 180 185 190  
 Thr Asn Asp Ser Leu Arg Lys Ala Asp Ser Asn Ser Val Pro Ala Leu  
 195 200 205  
 Arg Phe Ala Glu Ala Ile Lys Asp Ser Ala Tyr Arg Ser Ala Leu Phe  
 210 215 220  
 Ser Ala Phe Ala Asn Gly Trp Ser Asn Phe Gly Val Arg Val Ala Val  
 225 230 235 240  
 Leu Pro Leu Phe Ala Ala Ala Ala Phe Ser Asn Gly Gly Ala Ile Ala  
 245 250 255  
 Gly Phe Ala Met Ala Ala Phe Ala Ala Gly Asn Ala Leu Cys Leu Gln  
 260 265 270  
 Phe Ala Gly Asp Leu Ser Asp Arg Ile Gly Arg Lys Pro Met Ile Ile  
 275 280 285  
 Ser Gly Leu Ile Val Asn Ala Val Phe Thr Ala Met Ile Gly Phe Gly  
 290 295 300  
 Thr Glu Val Trp Ile Leu Ile Thr Val Ser Ala Leu Ala Gly Ala Gly  
 305 310 315 320

Ala Gly Leu Leu Asn Pro Ser Gln Gln Ala Val Leu Ala Asp Val Ile  
 325 330 335

Asp Ser Arg Pro Gly Gly Lys Val Leu Ala Asn Phe Gln Met Ala Gln  
 340 345 350

Asp Phe Gly Ala Ile Val Gly Pro Ile Leu Val Gly Met Ile Ala Glu  
 355 360 365

Gln Ala Gly Phe Gln Ile Gly Phe Met Leu Cys Gly Val Ile Ser Leu  
 370 375 380

Leu Ala Ala Val Ala Trp Ile Phe Gly Arg Glu Thr Leu Pro Thr Ala  
 385 390 395 400

Lys Val Glu Gln Val  
 405

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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1216)  
 <223> RXA00764

<400> 263  
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 acctgggacg actggattat taggggtgga attttcgctc atg aca ctc aag act 115  
 Met Thr Leu Lys Thr  
 1 5

agc gtt ttg gca cta ctc tta gat aac gtg cat gtt ctt ctg att gcg 163  
 Ser Val Leu Ala Leu Leu Leu Asp Asn Val His Val Leu Leu Ile Ala  
 10 15 20

aat cct gag tcg acc acg cag acg cag aaa ctt ttc cgt cgt gtg gtg 211  
 Asn Pro Glu Ser Thr Thr Gln Thr Gln Lys Leu Phe Arg Arg Val Val  
 25 30 35

cct gcg ttg atg gcg ctt gat ggt gtg tcg ctt gaa gcg agg ttt acg 259  
 Pro Ala Leu Met Ala Leu Asp Gly Val Ser Leu Glu Ala Arg Phe Thr  
 40 45 50

cac tat gga ggc cat gcg gag gaa atg gtt gcg ggt ttg acg gtg gat 307  
 His Tyr Gly Gly His Ala Glu Glu Met Val Ala Gly Leu Thr Val Asp  
 55 60 65

gat ttt gat gtg att atc ccc gcg ggt ggg gac ggc acc gtc aac gaa 355  
 Asp Phe Asp Val Ile Ile Pro Ala Gly Gly Asp Gly Thr Val Asn Glu  
 70 75 80 85

gtg ata aat ggg tta ctt ggg tcg gcg gaa ggt gat ttt aga aac ctt 403

Val	Ile	Asn	Gly	Leu	Leu	Gly	Ser	Ala	Glu	Gly	Asp	Phe	Arg	Asn	Leu		
				90					95					100			
.																	
gag	gat	ttg	ccg	gcg	att	gcg	gtg	ttg	cca	acg	ggg	tct	gcc	aat	gtg	451	
Glu	Asp	Leu	Pro	Ala	Ile	Ala	Val	Leu	Pro	Thr	Gly	Ser	Ala	Asn	Val		
			105					110					115				
ttt	gcc	cgt	gcg	ctt	ggt	tac	ccc	act	gac	ccg	tat	gct	gcc	gct	gat	499	
Phe	Ala	Arg	Ala	Leu	Gly	Tyr	Pro	Thr	Asp	Pro	Tyr	Ala	Ala	Ala	Asp		
		120					125					130					
gcc	ctg	gtg	gag	ttg	att	cgg	aag	aac	cac	acc	aga	act	atc	acc	ttg	547	
Ala	Leu	Val	Glu	Leu	Ile	Arg	Lys	Asn	His	Thr	Arg	Thr	Ile	Thr	Leu		
	135					140					145						
ggt	acg	tgg	aag	ggt	gat	gat	cag	ggg	act	cgt	tgg	ttc	gcg	gtt	aat	595	
Gly	Thr	Trp	Lys	Gly	Asp	Asp	Gln	Gly	Thr	Arg	Trp	Phe	Ala	Val	Asn		
150				155				160							165		
gct	ggg	ttt	ggt	att	gat	gcg	gat	gtt	att	gcc	agg	gtc	gaa	cgg	gcg	643	
Ala	Gly	Phe	Gly	Ile	Asp	Ala	Asp	Val	Ile	Ala	Arg	Val	Glu	Arg	Ala		
			170					175						180			
aga	tct	ttc	ggc	ttt	gcg	gct	tca	ccg	ttg	ttg	tat	ctg	cag	gtg	agt	691	
Arg	Ser	Phe	Gly	Phe	Ala	Ala	Ser	Pro	Leu	Leu	Tyr	Leu	Gln	Val	Ser		
		185					190						195				
ctt	cgg	gcg	tgg	gtg	aaa	act	cag	att	aag	cca	ccg	aaa	att	acc	gtg	739	
Leu	Arg	Ala	Trp	Val	Lys	Thr	Gln	Ile	Lys	Pro	Pro	Lys	Ile	Thr	Val		
	200						205					210					
gag	gcg	gtg	gac	agc	aaa	ggg	cac	aaa	ttg	caa	aaa	gag	gaa	gtg	cca	787	
Glu	Ala	Val	Asp	Ser	Lys	Gly	His	Lys	Leu	Gln	Lys	Glu	Glu	Val	Pro		
	215					220				225							
atg	ctg	ctt	gcc	tcg	aat	acc	aat	ccg	tgg	act	ttt	ttg	ggt	ccg	ctt	835	
Met	Leu	Leu	Ala	Ser	Asn	Thr	Asn	Pro	Trp	Thr	Phe	Leu	Gly	Pro	Leu		
230					235				240					245			
cct	gtg	gtg	aca	aat	ccg	cag	aat	tct	ttt	gac	aca	ggt	ctg	ggg	ctt	883	
Pro	Val	Val	Thr	Asn	Pro	Gln	Asn	Ser	Phe	Asp	Thr	Gly	Leu	Gly	Leu		
			250					255					260				
ttt	ggc	ttg	act	agt	gtg	cga	gga	ttc	ggg	gga	gtg	gca	gcg	atg	atg	931	
Phe	Gly	Leu	Thr	Ser	Val	Arg	Gly	Phe	Gly	Gly	Val	Ala	Ala	Met	Met		
		265					270					275					
cac	ctg	att	ggc	gtg	ggg	cat	ggt	cgg	aag	ttg	gag	aag	ttg	atc	gct	979	
His	Leu	Ile	Gly	Val	Gly	His	Gly	Arg	Lys	Leu	Glu	Lys	Leu	Ile	Ala		
		280				285					290						
aag	cgc	acc	att	gct	ttt	gat	gat	gcg	gag	aaa	gta	acg	ctc	acg	tgc	1027	
Lys	Arg	Thr	Ile	Ala	Phe	Asp	Asp	Ala	Glu	Lys	Val	Thr	Leu	Thr	Cys		
	295					300				305							
gac	agc	gat	cag	cgt	ttc	caa	gtt	gat	ggt	gag	tat	gaa	ggc	aaa	cca	1075	
Asp	Ser	Asp	Gln	Arg	Phe	Gln	Val	Asp	Gly	Glu	Tyr	Glu	Gly	Lys	Pro		

310                      315                      320                      325  
 aca aag gtg gtg ttg gaa tca atc act gat gcg gtg cga gtg tat gcg 1123  
 Thr Lys Val Val Leu Glu Ser Ile Thr Asp Ala Val Arg Val Tyr Ala  
                          330                      335                      340  
  
 ccg aag acg cat ccg aca ccg ccg atc atg aat tgg gct gtc cat ttg 1171  
 Pro Lys Thr His Pro Thr Pro Pro Ile Met Asn Trp Ala Val His Leu  
                          345                      350                      355  
  
 ttt aag cac gtc cgt gat ttc ctc cgg gtg cgc acg ttt ggc atc 1216  
 Phe Lys His Val Arg Asp Phe Leu Arg Val Arg Thr Phe Gly Ile  
                          360                      365                      370  
  
 taggattcat cggagttttc ttc 1239  
  
 <210> 264  
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 <212> PRT  
 <213> Corynebacterium glutamicum  
  
 <400> 264  
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   1                      5                      10                      15  
  
 Val Leu Leu Ile Ala Asn Pro Glu Ser Thr Thr Gln Thr Gln Lys Leu  
                          20                      25                      30  
  
 Phe Arg Arg Val Val Pro Ala Leu Met Ala Leu Asp Gly Val Ser Leu  
                          35                      40                      45  
  
 Glu Ala Arg Phe Thr His Tyr Gly Gly His Ala Glu Glu Met Val Ala  
                          50                      55                      60  
  
 Gly Leu Thr Val Asp Asp Phe Asp Val Ile Ile Pro Ala Gly Gly Asp  
   65                      70                      75                      80  
  
 Gly Thr Val Asn Glu Val Ile Asn Gly Leu Leu Gly Ser Ala Glu Gly  
                          85                      90                      95  
  
 Asp Phe Arg Asn Leu Glu Asp Leu Pro Ala Ile Ala Val Leu Pro Thr  
                          100                      105                      110  
  
 Gly Ser Ala Asn Val Phe Ala Arg Ala Leu Gly Tyr Pro Thr Asp Pro  
                          115                      120                      125  
  
 Tyr Ala Ala Ala Asp Ala Leu Val Glu Leu Ile Arg Lys Asn His Thr  
                          130                      135                      140  
  
 Arg Thr Ile Thr Leu Gly Thr Trp Lys Gly Asp Asp Gln Gly Thr Arg  
   145                      150                      155                      160  
  
 Trp Phe Ala Val Asn Ala Gly Phe Gly Ile Asp Ala Asp Val Ile Ala  
                          165                      170                      175  
  
 Arg Val Glu Arg Ala Arg Ser Phe Gly Phe Ala Ala Ser Pro Leu Leu

180 185 190  
 Tyr Leu Gln Val Ser Leu Arg Ala Trp Val Lys Thr Gln Ile Lys Pro  
 195 200 205  
 Pro Lys Ile Thr Val Glu Ala Val Asp Ser Lys Gly His Lys Leu Gln  
 210 215 220  
 Lys Glu Glu Val Pro Met Leu Leu Ala Ser Asn Thr Asn Pro Trp Thr  
 225 230 235 240  
 Phe Leu Gly Pro Leu Pro Val Val Thr Asn Pro Gln Asn Ser Phe Asp  
 245 250 255  
 Thr Gly Leu Gly Leu Phe Gly Leu Thr Ser Val Arg Gly Phe Gly Gly  
 260 265 270  
 Val Ala Ala Met Met His Leu Ile Gly Val Gly His Gly Arg Lys Leu  
 275 280 285  
 Glu Lys Leu Ile Ala Lys Arg Thr Ile Ala Phe Asp Asp Ala Glu Lys  
 290 295 300  
 Val Thr Leu Thr Cys Asp Ser Asp Gln Arg Phe Gln Val Asp Gly Glu  
 305 310 315 320  
 Tyr Glu Gly Lys Pro Thr Lys Val Val Leu Glu Ser Ile Thr Asp Ala  
 325 330 335  
 Val Arg Val Tyr Ala Pro Lys Thr His Pro Thr Pro Pro Ile Met Asn  
 340 345 350  
 Trp Ala Val His Leu Phe Lys His Val Arg Asp Phe Leu Arg Val Arg  
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 Thr Phe Gly Ile  
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<220>  
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 <223> RXN03125

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 tcgcctcggc gacgtcctgg ttccttacgt tctgatcggt ttg gtt cta gcg ttc 115  
 Leu Val Leu Ala Phe  
 1 5  
 ctc gtg ctg ttg ctc gtg ttc cgg tcc att tgg gtc cca ttg atc gcg 163

Leu Val Leu Leu Leu Val Phe Arg Ser Ile Trp Val Pro Leu Ile Ala  
 10 15 20

gct ctg ggc ttt ggc ttg tca gtt ctg gct acc ttt ggt gct acc gtg 211  
 Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr Phe Gly Ala Thr Val  
 25 30 35

gcg atc ttc caa gaa ggt gct ttc ggc atc atc gac gat cct cag cca 259  
 Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile Asp Asp Pro Gln Pro  
 40 45 50

ctg ctg tgc ttc 271  
 Leu Leu Cys Phe  
 55

<210> 266  
 <211> 57  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 266  
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 1 5 10 15

Val Pro Leu Ile Ala Ala Leu Gly Phe Gly Leu Ser Val Leu Ala Thr  
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Phe Gly Ala Thr Val Ala Ile Phe Gln Glu Gly Ala Phe Gly Ile Ile  
 35 40 45

Asp Asp Pro Gln Pro Leu Leu Cys Phe  
 50 55

<210> 267  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1420)  
 <223> RXN01553

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taccaagcca gacttaaatt tctaccttaa agtcttgagc atg act gtt cag gaa 115  
 Met Thr Val Gln Glu  
 1 5

ttc gac cgc gcg acc aaa ccc aca cca aaa ccc cca att gtt tct tgg 163  
 Phe Asp Arg Ala Thr Lys Pro Thr Pro Lys Pro Pro Ile Val Ser Trp  
 10 15 20

gcg ttt tgg gat tgg ggt tcc gcc tct ttc aac gcg gtc ctc gtg acc 211

Ala	Phe	Trp	Asp	Trp	Gly	Ser	Ala	Ser	Phe	Asn	Ala	Val	Leu	Val	Thr		
			25					30					35				
ttt	att	ttc	tcg	gtc	tat	ctc	act	gat	tca	gtc	ggc	gcc	acc	ctc	ccc	259	
Phe	Ile	Phe	Ser	Val	Tyr	Leu	Thr	Asp	Ser	Val	Gly	Ala	Thr	Leu	Pro		
		40					45					50					
gag	ggt	tcc	aac	gcc	aca	tca	ctg	tat	tcg	atg	gcg	gtc	gcc	atc	gct	307	
Glu	Gly	Ser	Asn	Ala	Thr	Ser	Leu	Tyr	Ser	Met	Ala	Val	Ala	Ile	Ala		
	55					60					65						
ggc	gtc	att	gtt	gcg	gtt	gtt	gcc	cca	gtc	atg	ggc	agg	cga	tca	gat	355	
Gly	Val	Ile	Val	Ala	Val	Val	Ala	Pro	Val	Met	Gly	Arg	Arg	Ser	Asp		
70					75				80						85		
atc	aag	ggc	act	cgc	cgc	agg	tca	ctg	cgc	atg	tgg	aca	ctt	gtc	acc	403	
Ile	Lys	Gly	Thr	Arg	Arg	Arg	Ser	Leu	Arg	Met	Trp	Thr	Leu	Val	Thr		
				90					95					100			
gtg	ttc	ttg	atg	ttt	tgt	ctc	ttt	aca	gta	aag	aac	act	gat	ccc	aca	451	
Val	Phe	Leu	Met	Phe	Cys	Leu	Phe	Thr	Val	Lys	Asn	Thr	Asp	Pro	Thr		
			105					110					115				
ttt	ttc	tgg	ttt	ggt	gta	gcc	atc	atg	gcg	atc	gcc	aac	atc	acc	ttt	499	
Phe	Phe	Trp	Phe	Gly	Val	Ala	Ile	Met	Ala	Ile	Ala	Asn	Ile	Thr	Phe		
		120					125					130					
gag	ttc	gct	gaa	gtt	cag	tac	tat	gcg	cag	ctc	tcc	caa	atc	tcg	acc	547	
Glu	Phe	Ala	Glu	Val	Gln	Tyr	Tyr	Ala	Gln	Leu	Ser	Gln	Ile	Ser	Thr		
	135					140					145						
cgc	gaa	aac	gtg	ggc	cga	gtt	tct	ggt	ttc	ggc	tgg	tcc	atg	ggt	tac	595	
Arg	Glu	Asn	Val	Gly	Arg	Val	Ser	Gly	Phe	Gly	Trp	Ser	Met	Gly	Tyr		
150					155					160					165		
ttc	ggt	ggc	atc	gtt	cta	ctg	ctt	gtt	tgt	tac	cta	ggt	ttt	gtt	gcc	643	
Phe	Gly	Gly	Ile	Val	Leu	Leu	Leu	Val	Cys	Tyr	Leu	Gly	Phe	Val	Ala		
				170				175						180			
ggt	gat	ggc	gat	acc	cgc	gga	ttc	cta	aac	ctg	ccc	atc	gaa	gac	ggc	691	
Gly	Asp	Gly	Asp	Thr	Arg	Gly	Phe	Leu	Asn	Leu	Pro	Ile	Glu	Asp	Gly		
			185					190					195				
atg	aat	atc	cgc	ctc	gtc	gca	gtg	ctt	gca	gcc	gtt	tgg	ttc	ttg	gtc	739	
Met	Asn	Ile	Arg	Leu	Val	Ala	Val	Leu	Ala	Ala	Val	Trp	Phe	Leu	Val		
		200					205					210					
tct	gcg	att	ccg	gca	ctt	ctt	cga	gtc	cca	gaa	att	gag	gca	cag	gta	787	
Ser	Ala	Ile	Pro	Ala	Leu	Leu	Arg	Val	Pro	Glu	Ile	Glu	Ala	Gln	Val		
	215					220					225						
gct	gcc	gaa	gac	cac	ccc	aaa	ggc	ctc	ata	gct	gcc	tac	aag	gat	ctc	835	
Ala	Ala	Glu	Asp	His	Pro	Lys	Gly	Leu	Ile	Ala	Ala	Tyr	Lys	Asp	Leu		
230					235				240						245		
ttt	ggg	cag	atc	gct	gag	ctg	tgg	aaa	caa	gac	cgc	aac	tcc	gtg	tat	883	
Phe	Gly	Gln	Ile	Ala	Glu	Leu	Trp	Lys	Gln	Asp	Arg	Asn	Ser	Val	Tyr		



250	255	260	
ttc ctc atc gca gca act gtt ttc cgt gac gga ctc gcc gga gta ttt			931
Phe Leu Ile Ala Ala Thr Val Phe Arg Asp Gly Leu Ala Gly Val Phe			
265	270	275	
acc ttc ggt gcc atc ctt gcg gtc tct gtg tac gga cta tct gcc ggt			979
Thr Phe Gly Ala Ile Leu Ala Val Ser Val Tyr Gly Leu Ser Ala Gly			
280	285	290	
gat gtc ctc ctc ttc ggt gtc gca gcc aac gtg gtc tct gcg ttg gga			1027
Asp Val Leu Leu Phe Gly Val Ala Ala Asn Val Val Ser Ala Leu Gly			
295	300	305	
gca ctc ctc gga gga ttc cta gac gat cgc gtc ggg cca aaa ccc atc			1075
Ala Leu Leu Gly Gly Phe Leu Asp Asp Arg Val Gly Pro Lys Pro Ile			
310	315	320	325
atc ttg att tct ctt gcc atc atg atc gcc gat gct gca att ctc ttc			1123
Ile Leu Ile Ser Leu Ala Ile Met Ile Ala Asp Ala Ala Ile Leu Phe			
330	335	340	
ttc gtt gaa ggc ccc act aat ttc tgg atc ttc gga tta atc ctc tgt			1171
Phe Val Glu Gly Pro Thr Asn Phe Trp Ile Phe Gly Leu Ile Leu Cys			
345	350	355	
gcg ttt gtg gga cct gca cag tca gcg tcg aga agc tat tta aca cgt			1219
Ala Phe Val Gly Pro Ala Gln Ser Ala Ser Arg Ser Tyr Leu Thr Arg			
360	365	370	
ctt tcc cca gat ggc cag gaa ggc cag ctc ttc ggc ctt tat gcc act			1267
Leu Ser Pro Asp Gly Gln Glu Gly Gln Leu Phe Gly Leu Tyr Ala Thr			
375	380	385	
acc ggc cgt gcc gtg agt tgg atg gtg ccg tcg ctg ttt ggt gta ttt			1315
Thr Gly Arg Ala Val Ser Trp Met Val Pro Ser Leu Phe Gly Val Phe			
390	395	400	405
gtg ggg ctc acc ggc gat gac cgc act ggt att ttg gcc atc gcg ctg			1363
Val Gly Leu Thr Gly Asp Asp Arg Thr Gly Ile Leu Ala Ile Ala Leu			
410	415	420	
att ctg cta ttc ggt att gtg ctg ctg agc atg gtg aag cca ccg cac			1411
Ile Leu Leu Phe Gly Ile Val Leu Leu Ser Met Val Lys Pro Pro His			
425	430	435	
aag gtg aag tagacaaagc gcccacaagg att			1443
Lys Val Lys			
440			

&lt;210&gt; 268

&lt;211&gt; 440

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 268

Met Thr Val Gln Glu Phe Asp Arg Ala Thr Lys Pro Thr Pro Lys Pro  
 1 5 10 15  
 Pro Ile Val Ser Trp Ala Phe Trp Asp Trp Gly Ser Ala Ser Phe Asn  
 20 25 30  
 Ala Val Leu Val Thr Phe Ile Phe Ser Val Tyr Leu Thr Asp Ser Val  
 35 40 45  
 Gly Ala Thr Leu Pro Glu Gly Ser Asn Ala Thr Ser Leu Tyr Ser Met  
 50 55 60  
 Ala Val Ala Ile Ala Gly Val Ile Val Ala Val Val Ala Pro Val Met  
 65 70 75 80  
 Gly Arg Arg Ser Asp Ile Lys Gly Thr Arg Arg Arg Ser Leu Arg Met  
 85 90 95  
 Trp Thr Leu Val Thr Val Phe Leu Met Phe Cys Leu Phe Thr Val Lys  
 100 105 110  
 Asn Thr Asp Pro Thr Phe Phe Trp Phe Gly Val Ala Ile Met Ala Ile  
 115 120 125  
 Ala Asn Ile Thr Phe Glu Phe Ala Glu Val Gln Tyr Tyr Ala Gln Leu  
 130 135 140  
 Ser Gln Ile Ser Thr Arg Glu Asn Val Gly Arg Val Ser Gly Phe Gly  
 145 150 155 160  
 Trp Ser Met Gly Tyr Phe Gly Gly Ile Val Leu Leu Leu Val Cys Tyr  
 165 170 175  
 Leu Gly Phe Val Ala Gly Asp Gly Asp Thr Arg Gly Phe Leu Asn Leu  
 180 185 190  
 Pro Ile Glu Asp Gly Met Asn Ile Arg Leu Val Ala Val Leu Ala Ala  
 195 200 205  
 Val Trp Phe Leu Val Ser Ala Ile Pro Ala Leu Leu Arg Val Pro Glu  
 210 215 220  
 Ile Glu Ala Gln Val Ala Ala Glu Asp His Pro Lys Gly Leu Ile Ala  
 225 230 235 240  
 Ala Tyr Lys Asp Leu Phe Gly Gln Ile Ala Glu Leu Trp Lys Gln Asp  
 245 250 255  
 Arg Asn Ser Val Tyr Phe Leu Ile Ala Ala Thr Val Phe Arg Asp Gly  
 260 265 270  
 Leu Ala Gly Val Phe Thr Phe Gly Ala Ile Leu Ala Val Ser Val Tyr  
 275 280 285  
 Gly Leu Ser Ala Gly Asp Val Leu Leu Phe Gly Val Ala Ala Asn Val  
 290 295 300

Val Ser Ala Leu Gly Ala Leu Leu Gly Gly Phe Leu Asp Asp Arg Val  
 305 310 315 320  
 Gly Pro Lys Pro Ile Ile Leu Ile Ser Leu Ala Ile Met Ile Ala Asp  
 325 330 335  
 Ala Ala Ile Leu Phe Phe Val Glu Gly Pro Thr Asn Phe Trp Ile Phe  
 340 345 350  
 Gly Leu Ile Leu Cys Ala Phe Val Gly Pro Ala Gln Ser Ala Ser Arg  
 355 360 365  
 Ser Tyr Leu Thr Arg Leu Ser Pro Asp Gly Gln Glu Gly Gln Leu Phe  
 370 375 380  
 Gly Leu Tyr Ala Thr Thr Gly Arg Ala Val Ser Trp Met Val Pro Ser  
 385 390 395 400  
 Leu Phe Gly Val Phe Val Gly Leu Thr Gly Asp Asp Arg Thr Gly Ile  
 405 410 415  
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 420 425 430  
 Val Lys Pro Pro His Lys Val Lys  
 435 440

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 <213> Corynebacterium glutamicum

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 <223> RXN00535

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 Met Trp Trp Ala Gly  
 1 5  
 atg agt acc gcg atg ctg gca tat ttc tta caa aca gta gca ctt ggt 163  
 Met Ser Thr Ala Met Leu Ala Tyr Phe Leu Gln Thr Val Ala Leu Gly  
 10 15 20  
 ttc ggc acc ctc ttg gta gtg caa cca gtg ctt gtc ctg tcg ctg atg 211  
 Phe Gly Thr Leu Leu Val Val Gln Pro Val Leu Val Leu Ser Leu Met  
 25 30 35  
 ttc acg ctg ccg ctc tca gca cga ttc aat ggc tac cga cta cgc cga 259  
 Phe Thr Leu Pro Leu Ser Ala Arg Phe Asn Gly Tyr Arg Leu Arg Arg  
 40 45 50

act gaa atc ttc tgg gct acc ctc ctc acc gta gcc gtg ggc atc atg 307  
 Thr Glu Ile Phe Trp Ala Thr Leu Leu Thr Val Ala Val Gly Ile Met  
 55 60 65

atc gtt ttg gga cgc ccc ctt ccc gga aac ccc cac ccc cca ctc gat 355  
 Ile Val Leu Gly Arg Pro Leu Pro Gly Asn Pro His Pro Pro Leu Asp  
 70 75 80 85

cga tgg att cca gta ctt tta gtc ggc gtt gca gta atg ggt gga atg 403  
 Arg Trp Ile Pro Val Leu Leu Val Gly Val Ala Val Met Gly Gly Met  
 90 95 100

tgg ctg ctt gcg gaa tac gta tta aag aag gac aaa gcc ctc atc ctt 451  
 Trp Leu Leu Ala Glu Tyr Val Leu Lys Lys Asp Lys Ala Leu Ile Leu  
 105 110 115

ggt ctt gtg acg ggt gca ttg ttt ggc tac gta gca gtg atg tcc aaa 499  
 Gly Leu Val Thr Gly Ala Leu Phe Gly Tyr Val Ala Val Met Ser Lys  
 120 125 130

gcc gcg gtg gat ctt ttt gtc cat caa ggc ata acg gga ctc atc ttg 547  
 Ala Ala Val Asp Leu Phe Val His Gln Gly Ile Thr Gly Leu Ile Leu  
 135 140 145

aac tgg gaa ggc tac ggc cta atc ctc acc gca tta ctt gga aca atc 595  
 Asn Trp Glu Gly Tyr Gly Leu Ile Leu Thr Ala Leu Leu Gly Thr Ile  
 150 155 160 165

gtg cag cag tat tcc ttt aac gct ggc gaa cta caa aaa tcg cta ccc 643  
 Val Gln Gln Tyr Ser Phe Asn Ala Gly Glu Leu Gln Lys Ser Leu Pro  
 170 175 180

gcc atg acc att gcc gaa cca att gtt gcc ttc agt ttg ggc tac ttg 691  
 Ala Met Thr Ile Ala Glu Pro Ile Val Ala Phe Ser Leu Gly Tyr Leu  
 185 190 195

gtt ctg ggc gaa aaa ttc caa gtc gtg gac tgg gaa tgg atc gcc atg 739  
 Val Leu Gly Glu Lys Phe Gln Val Val Asp Trp Glu Trp Ile Ala Met  
 200 205 210

ggc atc gca cta ctg gtg atg att gtt tcc acc att gca ctg tct cgt 787  
 Gly Ile Ala Leu Leu Val Met Ile Val Ser Thr Ile Ala Leu Ser Arg  
 215 220 225

aca agc aca atg ccg gcc gga tcg aaa agg taaaactcca aagttccccc 837  
 Thr Ser Thr Met Pro Ala Gly Ser Lys Arg  
 230 235

cga 840

&lt;210&gt; 270

&lt;211&gt; 239

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 270

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 Thr Val Ala Leu Gly Phe Gly Thr Leu Leu Val Val Gln Pro Val Leu  
 20 25 30  
 Val Leu Ser Leu Met Phe Thr Leu Pro Leu Ser Ala Arg Phe Asn Gly  
 35 40 45  
 Tyr Arg Leu Arg Arg Thr Glu Ile Phe Trp Ala Thr Leu Leu Thr Val  
 50 55 60  
 Ala Val Gly Ile Met Ile Val Leu Gly Arg Pro Leu Pro Gly Asn Pro  
 65 70 75 80  
 His Pro Pro Leu Asp Arg Trp Ile Pro Val Leu Leu Val Gly Val Ala  
 85 90 95  
 Val Met Gly Gly Met Trp Leu Leu Ala Glu Tyr Val Leu Lys Lys Asp  
 100 105 110  
 Lys Ala Leu Ile Leu Gly Leu Val Thr Gly Ala Leu Phe Gly Tyr Val  
 115 120 125  
 Ala Val Met Ser Lys Ala Ala Val Asp Leu Phe Val His Gln Gly Ile  
 130 135 140  
 Thr Gly Leu Ile Leu Asn Trp Glu Gly Tyr Gly Leu Ile Leu Thr Ala  
 145 150 155 160  
 Leu Leu Gly Thr Ile Val Gln Gln Tyr Ser Phe Asn Ala Gly Glu Leu  
 165 170 175  
 Gln Lys Ser Leu Pro Ala Met Thr Ile Ala Glu Pro Ile Val Ala Phe  
 180 185 190  
 Ser Leu Gly Tyr Leu Val Leu Gly Glu Lys Phe Gln Val Val Asp Trp  
 195 200 205  
 Glu Trp Ile Ala Met Gly Ile Ala Leu Leu Val Met Ile Val Ser Thr  
 210 215 220  
 Ile Ala Leu Ser Arg Thr Ser Thr Met Pro Ala Gly Ser Lys Arg  
 225 230 235

<210> 271  
 <211> 2472  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(2449)  
 <223> RXN00453

<400> 271

375

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215 220 225	
ggc att ggt gcg ctg gca att gtg ctg gcc acg gcg ttt act gat ctc	835
Gly Ile Gly Ala Leu Ala Ile Val Leu Ala Thr Ala Phe Thr Asp Leu	
230 235 240 245	
aac aat gtg act cca gtg ctc gca gtg atg att ggc ctg gcc gtg ggc	883
Asn Asn Val Thr Pro Val Leu Ala Val Met Ile Gly Leu Ala Val Gly	
250 255 260	
att gac tac gcg ctg ttt att ttg tct agg tac cgt gcg gag tat aag	931
Ile Asp Tyr Ala Leu Phe Ile Leu Ser Arg Tyr Arg Ala Glu Tyr Lys	
265 270 275	
cgc atg cca cgt gcc gat gct gcc gga atg gcg gtg ggc aca gct ggt	979
Arg Met Pro Arg Ala Asp Ala Ala Gly Met Ala Val Gly Thr Ala Gly	
280 285 290	
agt gcg gtg gtg ttt gct ggc gcg acg gtg att atc gcg ctg gta gcc	1027
Ser Ala Val Val Phe Ala Gly Ala Thr Val Ile Ile Ala Leu Val Ala	
295 300 305	
ctc atc att gcg gat atc gga ttc ctc acg gcc atg ggt att tct gcg	1075
Leu Ile Ile Ala Asp Ile Gly Phe Leu Thr Ala Met Gly Ile Ser Ala	
310 315 320 325	
gcg ttt acg gtg ttc gtg gct gtg ctc att gcg ttg acg ttt atc ccg	1123
Ala Phe Thr Val Phe Val Ala Val Leu Ile Ala Leu Thr Phe Ile Pro	
330 335 340	
gcg ctg ttg ggt gtg ttt ggt ggt cat gcg ttc aag ggc aag atc cct	1171
Ala Leu Leu Gly Val Phe Gly Gly His Ala Phe Lys Gly Lys Ile Pro	
345 350 355	
gga att ggt gga aac cca acg cca aag cag acg tgg gag caa gcg ctt	1219
Gly Ile Gly Gly Asn Pro Thr Pro Lys Gln Thr Trp Glu Gln Ala Leu	
360 365 370	
aat cgt cgt tcc aag ggt cgc tca tgg gtc aag ctt gta cag aaa gca	1267
Asn Arg Arg Ser Lys Gly Arg Ser Trp Val Lys Leu Val Gln Lys Ala	
375 380 385	
ccg ggt ctt gtg gtg gca gtg gtg gtc ttg ggt ctt ggt gcc ttg acc	1315
Pro Gly Leu Val Val Ala Val Val Val Leu Gly Leu Gly Ala Leu Thr	
390 395 400 405	
att cct gca atg aac ctg cag ttg tca ctg cct tct gac tcc acc tcc	1363
Ile Pro Ala Met Asn Leu Gln Leu Ser Leu Pro Ser Asp Ser Thr Ser	
410 415 420	
aat att gat acc act cag cgt cag tcg gct gat ttg atg gca gag ggc	1411
Asn Ile Asp Thr Thr Gln Arg Gln Ser Ala Asp Leu Met Ala Glu Gly	
425 430 435	



ttt ggc gcg ggc gtt aat gcg ccg ttc ttg gtc atc gtc gat acg cat	1459
Phe Gly Ala Gly Val Asn Ala Pro Phe Leu Val Ile Val Asp Thr His	
440 445 450	
gag gtc aat gct gat tcc acc gca ttg cag cca ctg att gag gca cag	1507
Glu Val Asn Ala Asp Ser Thr Ala Leu Gln Pro Leu Ile Glu Ala Gln	
455 460 465	
gag cct gaa gag ggc gag ttc gat cgg gag cag gcg gct cgt ttt gct	1555
Glu Pro Glu Glu Gly Glu Phe Asp Arg Glu Gln Ala Ala Arg Phe Ala	
470 475 480 485	
acc tat atg tat gtc acc cag acc tac aat tcc aac atc gat gtg aag	1603
Thr Tyr Met Tyr Val Thr Gln Thr Tyr Asn Ser Asn Ile Asp Val Lys	
490 495 500	
aat gcg cag atc atc agc gtc aat gat gat ttc act gcg gcg cag att	1651
Asn Ala Gln Ile Ile Ser Val Asn Asp Asp Phe Thr Ala Ala Gln Ile	
505 510 515	
ctc gtg act cca tac acc gga cct gcg gat aaa gag acc cct gag ttg	1699
Leu Val Thr Pro Tyr Thr Gly Pro Ala Asp Lys Glu Thr Pro Glu Leu	
520 525 530	
atg cac gtg ctg cgt gcg cag gaa gct cag att gag gat gtt acg gga	1747
Met His Val Leu Arg Ala Gln Glu Ala Gln Ile Glu Asp Val Thr Gly	
535 540 545	
act gaa ctg ggt acc act ggg ttt acg gcg gtt cag ttg gac att act	1795
Thr Glu Leu Gly Thr Thr Gly Phe Thr Ala Val Gln Leu Asp Ile Thr	
550 555 560 565	
gag cag ctg gaa gac gca atg ccg gtt tac ctc gct gtg gtt gtt ggt	1843
Glu Gln Leu Glu Asp Ala Met Pro Val Tyr Leu Ala Val Val Val Gly	
570 575 580	
ttg gct att ttc ctc ctc att ctg gtg ttc cgt tcc ctg ctt gtt ccg	1891
Leu Ala Ile Phe Leu Leu Ile Leu Val Phe Arg Ser Leu Leu Val Pro	
585 590 595	
ctg gtt gct ggc ctt ggc ttc ttg ttg tct gtg ggt gcg gcc ttc ggt	1939
Leu Val Ala Gly Leu Gly Phe Leu Leu Ser Val Gly Ala Ala Phe Gly	
600 605 610	
gcg acg gtg ttg gtc tgg cag gag ggc ttc ggt ggc ttt gtg aac acc	1987
Ala Thr Val Leu Val Trp Gln Glu Gly Phe Gly Gly Phe Val Asn Thr	
615 620 625	
cct ggt ccg ctg att tcc ttc atg ccg atc ttc ctc atc ggc gtg acc	2035
Pro Gly Pro Leu Ile Ser Phe Met Pro Ile Phe Leu Ile Gly Val Thr	
630 635 640 645	
ttc ggt ttg gcc atg gac tat cag gtg ttc ctt gtg act cgc atg cgc	2083
Phe Gly Leu Ala Met Asp Tyr Gln Val Phe Leu Val Thr Arg Met Arg	
650 655 660	
gag cac tac acc cac cac aat ggc aag gga cag cct ggt tcc aag tac	2131

Glu His Tyr Thr His His Asn Gly Lys Gly Gln Pro Gly Ser Lys Tyr  
 665 670 675  
 acc ccg gtt gag cag tca gtg att gaa ggc ttc acg cag ggc tcc cgc 2179  
 Thr Pro Val Glu Gln Ser Val Ile Glu Gly Phe Thr Gln Gly Ser Arg  
 680 685 690  
 gtg gtt aca gca gcg gca ctg atc atg att gcc gtg ttc gtg gcg ttt 2227  
 Val Val Thr Ala Ala Ala Leu Ile Met Ile Ala Val Phe Val Ala Phe  
 695 700 705  
 att gat cag ccg ttg cca ttt att aag atc ttc ggt ttc gcg ttg ggt 2275  
 Ile Asp Gln Pro Leu Pro Phe Ile Lys Ile Phe Gly Phe Ala Leu Gly  
 710 715 720 725  
 gcg ggc gtg ttt ttc gat gct ttc ttc att cgc atg ggt ctg gtc ccc 2323  
 Ala Gly Val Phe Phe Asp Ala Phe Phe Ile Arg Met Gly Leu Val Pro  
 730 735 740  
 gcg tcg atg ttc ctg atg ggc aag gcc acg tgg tgg atg cct aag tgg 2371  
 Ala Ser Met Phe Leu Met Gly Lys Ala Thr Trp Trp Met Pro Lys Trp  
 745 750 755  
 ctg gat cga att ctg cca agt ttg gac att gaa ggc acc gca ctg gag 2419  
 Leu Asp Arg Ile Leu Pro Ser Leu Asp Ile Glu Gly Thr Ala Leu Glu  
 760 765 770  
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 Lys Glu Trp Glu Glu Lys Gln Ala Ala Arg  
 775 780  
 gat 2472

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 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 272  
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 Pro Ser Ile Asp Ala Thr Val Ser Leu Val Glu Asn Phe Pro Asp Gln  
 35 40 45  
 Thr Asn Pro Val Thr Ala Ala Gly Val Asn Val Val Phe Gln Ser Pro  
 50 55 60  
 Glu Gly Thr Thr Leu Asp Asp Pro Gln Met Met Thr Ala Met Asp Ala  
 65 70 75 80  
 Val Val Asp Tyr Ile Glu Asp Asn Leu Pro Asp Phe Gly Gly Gly Glu  
 85 90 95

Arg Phe Gly Asn Pro Val Glu Val Ser Pro Ala Leu Glu Glu Met Val  
 100 105 110  
 Ile Glu Gln Met Thr Ser Met Gly Leu Pro Glu Glu Thr Ala Ala Lys  
 115 120 125  
 Asp Ala Ala Asn Leu Ala Val Leu Ser Glu Asp Lys Thr Ile Gly Tyr  
 130 135 140  
 Thr Ser Phe Asn Ile Asp Val Glu Ala Ala Glu Tyr Val Glu Gln Lys  
 145 150 155 160  
 His Arg Asp Val Ile Asn Glu Ala Met Gln Ile Gly Glu Asp Leu Gly  
 165 170 175  
 Val Arg Val Glu Ala Gly Gly Pro Ala Phe Gly Asp Pro Ile Gln Ile  
 180 185 190  
 Glu Thr Thr Ser Glu Ile Ile Gly Ile Gly Ile Ala Phe Ile Val Leu  
 195 200 205  
 Ile Phe Thr Phe Gly Ser Leu Ile Ala Ala Gly Leu Pro Leu Ile Thr  
 210 215 220  
 Ala Val Ile Gly Val Gly Ile Gly Ala Leu Ala Ile Val Leu Ala Thr  
 225 230 235 240  
 Ala Phe Thr Asp Leu Asn Asn Val Thr Pro Val Leu Ala Val Met Ile  
 245 250 255  
 Gly Leu Ala Val Gly Ile Asp Tyr Ala Leu Phe Ile Leu Ser Arg Tyr  
 260 265 270  
 Arg Ala Glu Tyr Lys Arg Met Pro Arg Ala Asp Ala Ala Gly Met Ala  
 275 280 285  
 Val Gly Thr Ala Gly Ser Ala Val Val Phe Ala Gly Ala Thr Val Ile  
 290 295 300  
 Ile Ala Leu Val Ala Leu Ile Ile Ala Asp Ile Gly Phe Leu Thr Ala  
 305 310 315 320  
 Met Gly Ile Ser Ala Ala Phe Thr Val Phe Val Ala Val Leu Ile Ala  
 325 330 335  
 Leu Thr Phe Ile Pro Ala Leu Leu Gly Val Phe Gly Gly His Ala Phe  
 340 345 350  
 Lys Gly Lys Ile Pro Gly Ile Gly Gly Asn Pro Thr Pro Lys Gln Thr  
 355 360 365  
 Trp Glu Gln Ala Leu Asn Arg Arg Ser Lys Gly Arg Ser Trp Val Lys  
 370 375 380  
 Leu Val Gln Lys Ala Pro Gly Leu Val Val Ala Val Val Val Leu Gly  
 385 390 395 400

Leu Gly Ala Leu Thr Ile Pro Ala Met Asn Leu Gln Leu Ser Leu Pro  
 405 410 415  
 Ser Asp Ser Thr Ser Asn Ile Asp Thr Thr Gln Arg Gln Ser Ala Asp  
 420 425 430  
 Leu Met Ala Glu Gly Phe Gly Ala Gly Val Asn Ala Pro Phe Leu Val  
 435 440 445  
 Ile Val Asp Thr His Glu Val Asn Ala Asp Ser Thr Ala Leu Gln Pro  
 450 455 460  
 Leu Ile Glu Ala Gln Glu Pro Glu Glu Gly Glu Phe Asp Arg Glu Gln  
 465 470 475 480  
 Ala Ala Arg Phe Ala Thr Tyr Met Tyr Val Thr Gln Thr Tyr Asn Ser  
 485 490 495  
 Asn Ile Asp Val Lys Asn Ala Gln Ile Ile Ser Val Asn Asp Asp Phe  
 500 505 510  
 Thr Ala Ala Gln Ile Leu Val Thr Pro Tyr Thr Gly Pro Ala Asp Lys  
 515 520 525  
 Glu Thr Pro Glu Leu Met His Val Leu Arg Ala Gln Glu Ala Gln Ile  
 530 535 540  
 Glu Asp Val Thr Gly Thr Glu Leu Gly Thr Thr Gly Phe Thr Ala Val  
 545 550 555 560  
 Gln Leu Asp Ile Thr Glu Gln Leu Glu Asp Ala Met Pro Val Tyr Leu  
 565 570 575  
 Ala Val Val Val Gly Leu Ala Ile Phe Leu Leu Ile Leu Val Phe Arg  
 580 585 590  
 Ser Leu Leu Val Pro Leu Val Ala Gly Leu Gly Phe Leu Leu Ser Val  
 595 600 605  
 Gly Ala Ala Phe Gly Ala Thr Val Leu Val Trp Gln Glu Gly Phe Gly  
 610 615 620  
 Gly Phe Val Asn Thr Pro Gly Pro Leu Ile Ser Phe Met Pro Ile Phe  
 625 630 635 640  
 Leu Ile Gly Val Thr Phe Gly Leu Ala Met Asp Tyr Gln Val Phe Leu  
 645 650 655  
 Val Thr Arg Met Arg Glu His Tyr Thr His His Asn Gly Lys Gly Gln  
 660 665 670  
 Pro Gly Ser Lys Tyr Thr Pro Val Glu Gln Ser Val Ile Glu Gly Phe  
 675 680 685  
 Thr Gln Gly Ser Arg Val Val Thr Ala Ala Ala Leu Ile Met Ile Ala  
 690 695 700

Val Phe Val Ala Phe Ile Asp Gln Pro Leu Pro Phe Ile Lys Ile Phe  
705 710 715 720

Gly Phe Ala Leu Gly Ala Gly Val Phe Phe Asp Ala Phe Phe Ile Arg  
725 730 735

Met Gly Leu Val Pro Ala Ser Met Phe Leu Met Gly Lys Ala Thr Trp  
740 745 750

Trp Met Pro Lys Trp Leu Asp Arg Ile Leu Pro Ser Leu Asp Ile Glu  
755 760 765

Gly Thr Ala Leu Glu Lys Glu Trp Glu Glu Lys Gln Ala Ala Arg  
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<211> 597

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (101)..(574)

<223> RXN00932

<400> 273

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Met Thr Pro Gln Lys  
1 5

ctt cac cgt ttt gca gcc ctt tta gaa atg ggt acc tgg acc ctg ctg 163  
Leu His Arg Phe Ala Ala Leu Leu Glu Met Gly Thr Trp Thr Leu Leu  
10 15 20

atc atc ggc atg atc tta aaa tac agt gga gtg aca gac gcc gta acc 211  
Ile Ile Gly Met Ile Leu Lys Tyr Ser Gly Val Thr Asp Ala Val Thr  
25 30 35

cct att gcc ggc ggt atc cac ggc ttt ggc ttc ctc tgt ttt gca gcc 259  
Pro Ile Ala Gly Gly Ile His Gly Phe Gly Phe Leu Cys Phe Ala Ala  
40 45 50

atc acc atc acc gtg tgg atc aat aat aag tgg aca ttc ccg cag ggt 307  
Ile Thr Ile Thr Val Trp Ile Asn Asn Lys Trp Thr Phe Pro Gln Gly  
55 60 65

atc gca ggt ttg atc gtc tct gtt atc ccg tgg gct gca ttg cca ttt 355  
Ile Ala Gly Leu Ile Val Ser Val Ile Pro Trp Ala Ala Leu Pro Phe  
70 75 80 85

gca ttg tgg gca gac aag aag ggc ctc gtt gcc ggc gga tgg cgc ttt 403  
Ala Leu Trp Ala Asp Lys Lys Gly Leu Val Ala Gly Gly Trp Arg Phe  
90 95 100

tca gat ccg tcc gaa aag cca cac act ttc ttt gac aag atc ttg gct 451  
 Ser Asp Pro Ser Glu Lys Pro His Thr Phe Phe Asp Lys Ile Leu Ala  
                   105                                  110                                  115

caa ttg gtc agg cac cca atc cga tcc att tta att ctg ctg gtg att 499  
 Gln Leu Val Arg His Pro Ile Arg Ser Ile Leu Ile Leu Leu Val Ile  
                   120                                  125                                  130

atc gcc gtc gtc ttc tct atc ttg ctg gcg atg gga cca cct tat gat 547  
 Ile Ala Val Val Phe Ser Ile Leu Leu Ala Met Gly Pro Pro Tyr Asp  
                   135                                  140                                  145

cca gat gcc atc gca aac act gtg gat taaacaacag cctccttcac 594  
 Pro Asp Ala Ile Ala Asn Thr Val Asp  
 150                                  155

atg 597

<210> 274  
 <211> 158  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 274  
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                   20                                  25                                  30

Thr Asp Ala Val Thr Pro Ile Ala Gly Gly Ile His Gly Phe Gly Phe  
                   35                                  40                                  45

Leu Cys Phe Ala Ala Ile Thr Ile Thr Val Trp Ile Asn Asn Lys Trp  
                   50                                  55                                  60

Thr Phe Pro Gln Gly Ile Ala Gly Leu Ile Val Ser Val Ile Pro Trp  
   65                                  70                                  75                                  80

Ala Ala Leu Pro Phe Ala Leu Trp Ala Asp Lys Lys Gly Leu Val Ala  
                   85                                  90                                  95

Gly Gly Trp Arg Phe Ser Asp Pro Ser Glu Lys Pro His Thr Phe Phe  
                   100                                  105                                  110

Asp Lys Ile Leu Ala Gln Leu Val Arg His Pro Ile Arg Ser Ile Leu  
                   115                                  120                                  125

Ile Leu Leu Val Ile Ile Ala Val Val Phe Ser Ile Leu Leu Ala Met  
                   130                                  135                                  140

Gly Pro Pro Tyr Asp Pro Asp Ala Ile Ala Asn Thr Val Asp  
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 <223> RXN03022

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 Val Ile Ile Thr Ala Gly Ile Leu Val Ala Thr Ala Thr Ala Leu  
 1 5 10 15  
 cta atg atc acc gcg gtc agc gag tca acg tac atc gtc atc tcc ctc 157  
 Leu Met Ile Thr Ala Val Ser Glu Ser Thr Tyr Ile Val Ile Ser Leu  
 20 25 30  
 gcc ggc ttc tcc ctt tat ggc ctt ggc ctc gga ctc ttc gcc acc cca 205  
 Ala Gly Phe Ser Leu Tyr Gly Leu Gly Leu Gly Leu Phe Ala Thr Pro  
 35 40 45  
 gtc acc gat act gcg ctt gga aca ctt ccc aaa gac cgt acc ggc gct 253  
 Val Thr Asp Thr Ala Leu Gly Thr Leu Pro Lys Asp Arg Thr Gly Ala  
 50 55 60  
 ggt gca ggt gta ttc aag atg tcc tct tcc ctc ggc gca gca ctc ggc 301  
 Gly Ala Gly Val Phe Lys Met Ser Ser Ser Leu Gly Ala Ala Leu Gly  
 65 70 75  
 atc gca atc tcc act tca gtg ttc ctc gca ctt cgc gac ggc acc tcc 349  
 Ile Ala Ile Ser Thr Ser Val Phe Leu Ala Leu Arg Asp Gly Thr Ser  
 80 85 90 95  
 atc aac tcc gac gtc gca ctc gcc gga aca gtt tca ctt ggc atc aac 397  
 Ile Asn Ser Asp Val Ala Leu Ala Gly Thr Val Ser Leu Gly Ile Asn  
 100 105 110  
 gtt gta ttc gca gca aca gcc acc atc acc gca gca gtc ctt att cca 445  
 Val Val Phe Ala Ala Thr Ala Thr Ile Thr Ala Ala Val Leu Ile Pro  
 115 120 125  
 aaa gcc gct ggc aaa gtc tca caa acc agc atc acc ctt cct gag cca 493  
 Lys Ala Ala Gly Lys Val Ser Gln Thr Ser Ile Thr Leu Pro Glu Pro  
 130 135 140  
 gct atc gct gta aaa atc taaaacttca ccaggacaga taa 534  
 Ala Ile Ala Val Lys Ile  
 145

<210> 276  
 <211> 149  
 <212> PRT



&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 276

Val Ile Ile Thr Ala Gly Ile Leu Val Ala Thr Ala Thr Ala Leu Leu  
 1 5 10 15

Met Ile Thr Ala Val Ser Glu Ser Thr Tyr Ile Val Ile Ser Leu Ala  
 20 25 30

Gly Phe Ser Leu Tyr Gly Leu Gly Leu Gly Leu Phe Ala Thr Pro Val  
 35 40 45

Thr Asp Thr Ala Leu Gly Thr Leu Pro Lys Asp Arg Thr Gly Ala Gly  
 50 55 60

Ala Gly Val Phe Lys Met Ser Ser Ser Leu Gly Ala Ala Leu Gly Ile  
 65 70 75 80

Ala Ile Ser Thr Ser Val Phe Leu Ala Leu Arg Asp Gly Thr Ser Ile  
 85 90 95

Asn Ser Asp Val Ala Leu Ala Gly Thr Val Ser Leu Gly Ile Asn Val  
 100 105 110

Val Phe Ala Ala Thr Ala Thr Ile Thr Ala Ala Val Leu Ile Pro Lys  
 115 120 125

Ala Ala Gly Lys Val Ser Gln Thr Ser Ile Thr Leu Pro Glu Pro Ala  
 130 135 140

Ile Ala Val Lys Ile  
 145

&lt;210&gt; 277

&lt;211&gt; 586

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(586)

&lt;223&gt; RXN03151

&lt;400&gt; 277

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agtatttggt taaccatcca cctcaaggag taaaacgcac gtg ctt tcc cac atc 115  
 Val Leu Ser His Ile  
 1 5

att gat gtc ctc gcc gac ccg atc gat ggc acc cca ctt gta ggc gcc 163  
 Ile Asp Val Leu Ala Asp Pro Ile Asp Gly Thr Pro Leu Val Gly Ala  
 10 15 20

gaa gat ttc tca cgg ttg gtg tct gaa tct ggg cat tcc tac gat gtt 211  
 Glu Asp Phe Ser Arg Leu Val Ser Glu Ser Gly His Ser Tyr Asp Val

25	30	35	
gct cgt caa ggg tat gtc acc ctg gct ggt ggc gca ggt ctg cgc tat			259
Ala Arg Gln Gly Tyr Val Thr Leu Ala Gly Gly Ala Gly Leu Arg Tyr			
40	45	50	
tca ggc gat gat gca cag atg atc gcg gat cgg gaa acc ttc ctt tct			307
Ser Gly Asp Asp Ala Gln Met Ile Ala Asp Arg Glu Thr Phe Leu Ser			
55	60	65	
ggc ggt cac ttc gcg ccc ttc gtg gaa gct gtc acc gag cat gtt caa			355
Gly Gly His Phe Ala Pro Phe Val Glu Ala Val Thr Glu His Val Gln			
70	75	80	85
gat gtc gtt gac cag gca ggc ctt agc gat gac gca cag cca gtg gtc			403
Asp Val Val Asp Gln Ala Gly Leu Ser Asp Asp Ala Gln Pro Val Val			
90	95	100	
tgc gaa atc ggc gcg gga acc ggc tac tac ttg tcc cat acc ctt gat			451
Cys Glu Ile Gly Ala Gly Thr Gly Tyr Tyr Leu Ser His Thr Leu Asp			
105	110	115	
tct gtt gca gga tct cgc gga att ggc att gac gtt tcc gtg cac gcc			499
Ser Val Ala Gly Ser Arg Gly Ile Gly Ile Asp Val Ser Val His Ala			
120	125	130	
gca aag cgt ttg gca aag tgt cac cct cgc gtc ggc gca gtc atc gcg			547
Ala Lys Arg Leu Ala Lys Cys His Pro Arg Val Gly Ala Val Ile Ala			
135	140	145	
aac gca tgg gca cgc ctg ccg att gca gat aac tcc tcg			586
Asn Ala Trp Ala Arg Leu Pro Ile Ala Asp Asn Ser Ser			
150	155	160	

&lt;210&gt; 278

&lt;211&gt; 162

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 278

Val Leu Ser His Ile Ile Asp Val Leu Ala Asp Pro Ile Asp Gly Thr			
1	5	10	15
Pro Leu Val Gly Ala Glu Asp Phe Ser Arg Leu Val Ser Glu Ser Gly			
20	25	30	
His Ser Tyr Asp Val Ala Arg Gln Gly Tyr Val Thr Leu Ala Gly Gly			
35	40	45	
Ala Gly Leu Arg Tyr Ser Gly Asp Asp Ala Gln Met Ile Ala Asp Arg			
50	55	60	
Glu Thr Phe Leu Ser Gly Gly His Phe Ala Pro Phe Val Glu Ala Val			
65	70	75	80
Thr Glu His Val Gln Asp Val Val Asp Gln Ala Gly Leu Ser Asp Asp			

85 90 95  
 Ala Gln Pro Val Val Cys Glu Ile Gly Ala Gly Thr Gly Tyr Tyr Leu  
 100 105 110  
 Ser His Thr Leu Asp Ser Val Ala Gly Ser Arg Gly Ile Gly Ile Asp  
 115 120 125  
 Val Ser Val His Ala Ala Lys Arg Leu Ala Lys Cys His Pro Arg Val  
 130 135 140  
 Gly Ala Val Ile Ala Asn Ala Trp Ala Arg Leu Pro Ile Ala Asp Asn  
 145 150 155 160  
 Ser Ser

<210> 279  
 <211> 543  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
 <221> CDS  
 <222> (1)..(543)  
 <223> RXN02832

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 Arg Gly Pro Val Met Asp Tyr Thr Asn Gln Ser Leu Val Ala Phe Phe  
 1 5 10 15  
 ttt aaa gca tta acg tca tat tta aag aaa cac aat tgt tta tat gtc 96  
 Phe Lys Ala Leu Thr Ser Tyr Leu Lys Lys His Asn Cys Leu Tyr Val  
 20 25 30  
 ctt gta gat cca tat tta att gaa aat tta cgc aat gca gac ggt gaa 144  
 Leu Val Asp Pro Tyr Leu Ile Glu Asn Leu Arg Asn Ala Asp Gly Glu  
 35 40 45  
 att gtt aaa tct tat gat aac cga gca ttt gtt aga aca atg gat aaa 192  
 Ile Val Lys Ser Tyr Asp Asn Arg Ala Phe Val Arg Thr Met Asp Lys  
 50 55 60  
 tta ggt tat aaa cac caa ggt ttc cct gta ggt tat gat tca atg agc 240  
 Leu Gly Tyr Lys His Gln Gly Phe Pro Val Gly Tyr Asp Ser Met Ser  
 65 70 75 80  
 caa atc cgt tgg ctg tca gtg tta gat tta aaa gat aag act gaa gac 288  
 Gln Ile Arg Trp Leu Ser Val Leu Asp Leu Lys Asp Lys Thr Glu Asp  
 85 90 95  
 caa ctt tta aaa gaa atg gat tat caa acg aga cgt aat att aaa aaa 336  
 Gln Leu Leu Lys Glu Met Asp Tyr Gln Thr Arg Arg Asn Ile Lys Lys  
 100 105 110

aca tat gat att ggt gtc aaa act aaa acg tta acg att gat gaa acg 384  
 Thr Tyr Asp Ile Gly Val Lys Thr Lys Thr Leu Thr Ile Asp Glu Thr  
 115 120 125

caa act ttt ttc gac tta ttc cat atg gct gag gaa aag cac ggt ttc 432  
 Gln Thr Phe Phe Asp Leu Phe His Met Ala Glu Glu Lys His Gly Phe  
 130 135 140

aaa ttc cgt gag tta cca tac ttt gaa gaa atg caa aag tta tac gat 480  
 Lys Phe Arg Glu Leu Pro Tyr Phe Glu Glu Met Gln Lys Leu Tyr Asp  
 145 150 155 160

gac cac gcc atg tta aag ttg gcg tat att gat tta aac gag tat tta 528  
 Asp His Ala Met Leu Lys Leu Ala Tyr Ile Asp Leu Asn Glu Tyr Leu  
 165 170 175

aaa acg ttg caa tta 543  
 Lys Thr Leu Gln Leu  
 180

<210> 280  
 <211> 181  
 <212> PRT  
 <213> Corynebacterium glutamicum

<400> 280  
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Phe Lys Ala Leu Thr Ser Tyr Leu Lys Lys His Asn Cys Leu Tyr Val  
 20 25 30

Leu Val Asp Pro Tyr Leu Ile Glu Asn Leu Arg Asn Ala Asp Gly Glu  
 35 40 45

Ile Val Lys Ser Tyr Asp Asn Arg Ala Phe Val Arg Thr Met Asp Lys  
 50 55 60

Leu Gly Tyr Lys His Gln Gly Phe Pro Val Gly Tyr Asp Ser Met Ser  
 65 70 75 80

Gln Ile Arg Trp Leu Ser Val Leu Asp Leu Lys Asp Lys Thr Glu Asp  
 85 90 95

Gln Leu Leu Lys Glu Met Asp Tyr Gln Thr Arg Arg Asn Ile Lys Lys  
 100 105 110

Thr Tyr Asp Ile Gly Val Lys Thr Lys Thr Leu Thr Ile Asp Glu Thr  
 115 120 125

Gln Thr Phe Phe Asp Leu Phe His Met Ala Glu Glu Lys His Gly Phe  
 130 135 140

Lys Phe Arg Glu Leu Pro Tyr Phe Glu Glu Met Gln Lys Leu Tyr Asp  
 145 150 155 160

Asp His Ala Met Leu Lys Leu Ala Tyr Ile Asp Leu Asn Glu Tyr Leu  
 165 170 175

Lys Thr Leu Gln Leu  
 180

<210> 281  
 <211> 1539  
 <212> DNA  
 <213> Corynebacterium glutamicum

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 <222> (101)..(1516)  
 <223> RXN00165

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 Val Ala Ser Ala Gly  
 1 5  
 atg gcg gcg tct ttt atc tgc aat ggg tta acg cct gtg att gtg ggt 163  
 Met Ala Ala Ser Phe Ile Cys Asn Gly Leu Thr Pro Val Ile Val Gly  
 10 15 20  
 aag gcg gtg gat gag gct att ggc acg agc gat ctg cag cga ttg tgg 211  
 Lys Ala Val Asp Glu Ala Ile Gly Thr Ser Asp Leu Gln Arg Leu Trp  
 25 30 35  
 ttc tgg att gcc atg ttg gcg gtt ctt ttc tta acg gcg atg acg gtg 259  
 Phe Trp Ile Ala Met Leu Ala Val Leu Phe Leu Thr Ala Met Thr Val  
 40 45 50  
 aac tgg att gct cgg tac atg ttg gtg cgg agc cag cag ttg gtc agc 307  
 Asn Trp Ile Ala Arg Tyr Met Leu Val Arg Ser Gln Gln Leu Val Ser  
 55 60 65  
 cat gat ttg cgc atg ttg gtg act gat cgg att caa gat ccg cgt ggt 355  
 His Asp Leu Arg Met Leu Val Thr Asp Arg Ile Gln Asp Pro Arg Gly  
 70 75 80 85  
 ttt gct gga aaa gag cgc act gcg ggt gga ttg ttg tcg att gcg tca 403  
 Phe Ala Gly Lys Glu Arg Thr Ala Gly Gly Leu Leu Ser Ile Ala Ser  
 90 95 100  
 tcg gat acg cag cgg gtg ggc gat atc gtc atg atg acg gtg ttc ccg 451  
 Ser Asp Thr Gln Arg Val Gly Asp Ile Val Met Met Thr Val Phe Pro  
 105 110 115  
 gtg gcg gaa ttg gcg tcg att att tat ggc gcc gtg gtg atg tac agc 499  
 Val Ala Glu Leu Ala Ser Ile Ile Tyr Gly Ala Val Val Met Tyr Ser  
 120 125 130  
 att aat ccg tgg ttg agt gtg gct gtg ctg att ggt gga ccg ctg ctg 547

Ile	Asn	Pro	Trp	Leu	Ser	Val	Ala	Val	Leu	Ile	Gly	Gly	Pro	Leu	Leu		
135						140					145						
gtt	gtg	gtg	gct	att	cag	gtc	tca	aag	ccg	ttg	cag	aag	cgt	tcg	ggt	595	
Val	Val	Val	Ala	Ile	Gln	Val	Ser	Lys	Pro	Leu	Gln	Lys	Arg	Ser	Gly		
150					155					160					165		
gct	cgt	cag	cag	gcg	gtg	gca	cag	gct	gcg	gct	act	gca	act	gat	gtg	643	
Ala	Arg	Gln	Gln	Ala	Val	Ala	Gln	Ala	Ala	Ala	Thr	Ala	Thr	Asp	Val		
				170	-				175						180		
gtg	cag	ggc	ttg	aga	att	ttg	aag	ggt	ttg	ggc	gcg	att	gtc	acg	gtg	691	
Val	Gln	Gly	Leu	Arg	Ile	Leu	Lys	Gly	Leu	Gly	Ala	Ile	Val	Thr	Val		
			185					190						195			
cgc	cgt	cgg	tac	gag	gcg	att	tct	ggt	gag	gct	tat	cgg	aag	acg	gtt	739	
Arg	Arg	Arg	Tyr	Glu	Ala	Ile	Ser	Gly	Glu	Ala	Tyr	Arg	Lys	Thr	Val		
		200					205					210					
cat	gcg	gat	gct	gcg	gaa	gct	cgc	ttg	aat	ggt	gtc	acc	gat	gcg	gcg	787	
His	Ala	Asp	Ala	Ala	Glu	Ala	Arg	Leu	Asn	Gly	Val	Thr	Asp	Ala	Ala		
	215					220					225						
ggc	gcc	atc	ttt	gtg	tcc	gcg	ttg	ggt	att	gga	gca	gga	ttt	ttg	gcg	835	
Gly	Ala	Ile	Phe	Val	Ser	Ala	Leu	Gly	Ile	Gly	Ala	Gly	Phe	Leu	Ala		
230					235					240					245		
ctg	caa	ggt	cag	atg	agt	att	ggt	gat	ttg	atc	acg	gtt	gtg	gga	ctc	883	
Leu	Gln	Gly	Gln	Met	Ser	Ile	Gly	Asp	Leu	Ile	Thr	Val	Val	Gly	Leu		
				250					255					260			
aca	cag	ttt	ttg	atc	atg	ccg	atg	acc	atg	ctt	ggt	cga	aat	gtg	gca	931	
Thr	Gln	Phe	Leu	Ile	Met	Pro	Met	Thr	Met	Leu	Gly	Arg	Asn	Val	Ala		
			265					270					275				
tcg	cgc	tgg	gca	tcg	gcg	gag	gcg	tcg	gca	aag	cgt	att	agg	gga	gtg	979	
Ser	Arg	Trp	Ala	Ser	Ala	Glu	Ala	Ser	Ala	Lys	Arg	Ile	Arg	Gly	Val		
		280				285						290					
ctc	ggt	gct	gat	ttt	gag	aga	gtg	tct	gcg	cat	gat	gcg	gac	aag	gct	1027	
Leu	Gly	Ala	Asp	Phe	Glu	Arg	Val	Ser	Ala	His	Asp	Ala	Asp	Lys	Ala		
	295					300					305						
gag	gag	att	atc	caa	caa	ctt	gcc	aaa	ggt	ttg	acg	gtt	att	cga	ggc	1075	
Glu	Glu	Ile	Ile	Gln	Gln	Leu	Ala	Lys	Gly	Leu	Thr	Val	Ile	Arg	Gly		
310					315					320					325		
act	gat	gag	cag	ctc	gtt	gag	gta	tta	gag	cag	ttg	cca	cgt	act	cgg	1123	
Thr	Asp	Glu	Gln	Leu	Val	Glu	Val	Leu	Glu	Gln	Leu	Pro	Arg	Thr	Arg		
				330					335					340			
gtg	att	gtg	gct	cct	cat	gcg	gcg	gat	ctt	ttt	gat	caa	agt	gtc	agg	1171	
Val	Ile	Val	Ala	Pro	His	Ala	Ala	Asp	Leu	Phe	Asp	Gln	Ser	Val	Arg		
			345					350					355				
gac	aat	gtg	cat	ccc	gtg	gca	gag	gtc	gcg	gag	aaa	gcc	att	gaa	gtt	1219	
Asp	Asn	Val	His	Pro	Val	Ala	Glu	Val	Ala	Glu	Lys	Ala	Ile	Glu	Val		

360	365	370	
gcc tcc tgt gac gat att cca ggt ggt agt tcc aag att gtg ggc gag			1267
Ala Ser Cys Asp Asp Ile Pro Gly Gly Ser Ser Lys Ile Val Gly Glu			
375	380	385	
ggt gga cgg ttg ctc tcg ggt ggt cag cgt cag cgc gtt gca ctg gct			1315
Gly Gly Arg Leu Leu Ser Gly Gly Gln Arg Gln Arg Val Ala Leu Ala			
390	395	400	405
cgg gcg att gct ttt gat cca gag gtg ttg gtg ctt caa gat ccc aca			1363
Arg Ala Ile Ala Phe Asp Pro Glu Val Leu Val Leu Gln Asp Pro Thr			
	410	415	420
acg gca gtg gat tct gtg acg gag caa aac att gct cag caa gtg gca			1411
Thr Ala Val Asp Ser Val Thr Glu Gln Asn Ile Ala Gln Gln Val Ala			
	425	430	435
gca cac cgt gca gga aaa gtg acc att gtg ttt agt gag gca ccc gcg			1459
Ala His Arg Ala Gly Lys Val Thr Ile Val Phe Ser Glu Ala Pro Ala			
	440	445	450
tgg agt gcg gtg gct gat caa cac gtt gag gca gct gct ttg cgg gag			1507
Trp Ser Ala Val Ala Asp Gln His Val Glu Ala Ala Ala Leu Arg Glu			
	455	460	465
gtt atg aaa tgagtgggga gacgtcgaaa agc			1539
Val Met Lys			
470			

&lt;210&gt; 282

&lt;211&gt; 472

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 282

Val Ala Ser Ala Gly Met Ala Ala Ser Phe Ile Cys Asn Gly Leu Thr			
1	5	10	15
Pro Val Ile Val Gly Lys Ala Val Asp Glu Ala Ile Gly Thr Ser Asp			
	20	25	30
Leu Gln Arg Leu Trp Phe Trp Ile Ala Met Leu Ala Val Leu Phe Leu			
	35	40	45
Thr Ala Met Thr Val Asn Trp Ile Ala Arg Tyr Met Leu Val Arg Ser			
	50	55	60
Gln Gln Leu Val Ser His Asp Leu Arg Met Leu Val Thr Asp Arg Ile			
	65	70	75
Gln Asp Pro Arg Gly Phe Ala Gly Lys Glu Arg Thr Ala Gly Gly Leu			
	85	90	95
Leu Ser Ile Ala Ser Ser Asp Thr Gln Arg Val Gly Asp Ile Val Met			
	100	105	110



Met	Thr	Val	Phe	Pro	Val	Ala	Glu	Leu	Ala	Ser	Ile	Ile	Tyr	Gly	Ala		
		115					120					125					
Val	Val	Met	Tyr	Ser	Ile	Asn	Pro	Trp	Leu	Ser	Val	Ala	Val	Leu	Ile		
		130				135					140						
Gly	Gly	Pro	Leu	Leu	Val	Val	Val	Ala	Ile	Gln	Val	Ser	Lys	Pro	Leu		
145					150					155					160		
Gln	Lys	Arg	Ser	Gly	Ala	Arg	Gln	Gln	Ala	Val	Ala	Gln	Ala	Ala	Ala		
				165					170					175			
Thr	Ala	Thr	Asp	Val	Val	Gln	Gly	Leu	Arg	Ile	Leu	Lys	Gly	Leu	Gly		
			180					185					190				
Ala	Ile	Val	Thr	Val	Arg	Arg	Arg	Tyr	Glu	Ala	Ile	Ser	Gly	Glu	Ala		
		195					200					205					
Tyr	Arg	Lys	Thr	Val	His	Ala	Asp	Ala	Ala	Glu	Ala	Arg	Leu	Asn	Gly		
		210				215					220						
Val	Thr	Asp	Ala	Ala	Gly	Ala	Ile	Phe	Val	Ser	Ala	Leu	Gly	Ile	Gly		
225					230					235					240		
Ala	Gly	Phe	Leu	Ala	Leu	Gln	Gly	Gln	Met	Ser	Ile	Gly	Asp	Leu	Ile		
				245					250					255			
Thr	Val	Val	Gly	Leu	Thr	Gln	Phe	Leu	Ile	Met	Pro	Met	Thr	Met	Leu		
			260					265					270				
Gly	Arg	Asn	Val	Ala	Ser	Arg	Trp	Ala	Ser	Ala	Glu	Ala	Ser	Ala	Lys		
		275					280					285					
Arg	Ile	Arg	Gly	Val	Leu	Gly	Ala	Asp	Phe	Glu	Arg	Val	Ser	Ala	His		
		290				295					300						
Asp	Ala	Asp	Lys	Ala	Glu	Glu	Ile	Ile	Gln	Gln	Leu	Ala	Lys	Gly	Leu		
305					310					315					320		
Thr	Val	Ile	Arg	Gly	Thr	Asp	Glu	Gln	Leu	Val	Glu	Val	Leu	Glu	Gln		
				325					330					335			
Leu	Pro	Arg	Thr	Arg	Val	Ile	Val	Ala	Pro	His	Ala	Ala	Asp	Leu	Phe		
			340					345					350				
Asp	Gln	Ser	Val	Arg	Asp	Asn	Val	His	Pro	Val	Ala	Glu	Val	Ala	Glu		
		355					360					365					
Lys	Ala	Ile	Glu	Val	Ala	Ser	Cys	Asp	Asp	Ile	Pro	Gly	Gly	Ser	Ser		
		370				375					380						
Lys	Ile	Val	Gly	Glu	Gly	Gly	Arg	Leu	Leu	Ser	Gly	Gly	Gln	Arg	Gln		
385					390					395					400		
Arg	Val	Ala	Leu	Ala	Arg	Ala	Ile	Ala	Phe	Asp	Pro	Glu	Val	Leu	Val		
			405					410						415			

Leu Gln Asp Pro Thr Thr Ala Val Asp Ser Val Thr Glu Gln Asn Ile  
 420 425 430

Ala Gln Gln Val Ala Ala His Arg Ala Gly Lys Val Thr Ile Val Phe  
 435 440 445

Ser Glu Ala Pro Ala Trp Ser Ala Val Ala Asp Gln His Val Glu Ala  
 450 455 460

Ala Ala Leu Arg Glu Val Met Lys  
 465 470

<210> 283  
 <211> 1470  
 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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 <222> (101)..(1447)  
 <223> RXN01190

<400> 283  
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gcagcggggc aaggttgcggt ttggcgcatt ctttttgggg atg tgg cag ctg tcg 115  
 Met Trp Gln Leu Ser  
 1 5

gaa gca ttg gtg ccg att gcg att ggt ttg atc gtt gat cat gcg gtt 163  
 Glu Ala Leu Val Pro Ile Ala Ile Gly Leu Ile Val Asp His Ala Val  
 10 15 20

ctc aca aaa gat ctc cgc cga tta gtg gtc ggg ctt gtc gct ttt gtt 211  
 Leu Thr Lys Asp Leu Arg Arg Leu Val Val Gly Leu Val Ala Phe Val  
 25 30 35

gtg ctg ttt gtg gtg ttg agt ttt tct aat cgt ttc ggt tcg cgc gcg 259  
 Val Leu Phe Val Val Leu Ser Phe Ser Asn Arg Phe Gly Ser Arg Ala  
 40 45 50

ttg aat agg gcc gtg aac ttt gaa tcc cat gcg ctc cgc gta gag gta 307  
 Leu Asn Arg Ala Val Asn Phe Glu Ser His Ala Leu Arg Val Glu Val  
 55 60 65

gcc gat cat gcg ttg aag aat ctg gat ccg cgc aat ttg gtg cct ggc 355  
 Ala Asp His Ala Leu Lys Asn Leu Asp Pro Arg Asn Leu Val Pro Gly  
 70 75 80 85

gag gtg atg tcg cgg tcc acc gca gat gcg gat tct tcg acg cgt att 403  
 Glu Val Met Ser Arg Ser Thr Ala Asp Ala Asp Ser Ser Thr Arg Ile  
 90 95 100

ttc ggg cag atc gga acc ggt gtt tcg gct gcg acg gga ttt ctt ggt 451  
 Phe Gly Gln Ile Gly Thr Gly Val Ser Ala Ala Thr Gly Phe Leu Gly

105	110	115	
gca gcg acc tac ctg ttg atc agt gac tgg ctg gtc ggg ttg ttg gtg Ala Ala Thr Tyr Leu Leu Ile Ser Asp Trp Leu Val Gly Leu Leu Val 120 125 130			499
ctt gtg ctg gta ccg atc att tcg gga gtg gtt gca ctg gct agc aag Leu Val Leu Val Pro Ile Ile Ser Gly Val Val Ala Leu Ala Ser Lys 135 140 145			547
ggc att tct aaa agg agt gtc acc cag cag gag aag ttg gcg gag tct Gly Ile Ser Lys Arg Ser Val Thr Gln Gln Glu Lys Leu Ala Glu Ser 150 155 160 165			595
ggt gcg cag gca agt gac atc atg atg ggg ctg cgc gtg atc aag gcg Gly Ala Gln Ala Ser Asp Ile Met Met Gly Leu Arg Val Ile Lys Ala 170 175 180			643
atc ggt ggc gag cgt tgg gcc gtg aag act ttt gaa aag gcg tcg cag Ile Gly Gly Glu Arg Trp Ala Val Lys Thr Phe Glu Lys Ala Ser Gln 185 190 195			691
gca tca gcg aga gcg gcg gtt gat act gca gtt gct tcg ggc aaa gtc Ala Ser Ala Arg Ala Ala Val Asp Thr Ala Val Ala Ser Gly Lys Val 200 205 210			739
gct ggt att ggt gag ttg tcc att gcg gtg aat ttg gct gcg gtg ttg Ala Gly Ile Gly Glu Leu Ser Ile Ala Val Asn Leu Ala Ala Val Leu 215 220 225			787
ttg ctt gct ggt tgg cgg gtc acc acg ggg gag ttg ggg cct ggc cag Leu Leu Ala Gly Trp Arg Val Thr Thr Gly Glu Leu Gly Pro Gly Gln 230 235 240 245			835
ttg atc gca att gtg ggt gtg gcg gtg tat ttg tca gag ccg att cgc Leu Ile Ala Ile Val Gly Val Ala Val Tyr Leu Ser Glu Pro Ile Arg 250 255 260			883
ttg ctg agc aac tcg att aat gcc tca gct att gcg cac ggt gca gcg Leu Leu Ser Asn Ser Ile Asn Ala Ser Ala Ile Ala His Gly Ala Ala 265 270 275			931
gag cgg gtg gct aat ttc tta aac ctc gac gaa tct cag gca cag tac Glu Arg Val Ala Asn Phe Leu Asn Leu Asp Glu Ser Gln Ala Gln Tyr 280 285 290			979
gaa agc agc gaa aca atc aat gac ggc gaa ttc ctc gtc atc gtg ccc Glu Ser Ser Glu Thr Ile Asn Asp Gly Glu Phe Leu Val Ile Val Pro 295 300 305			1027
cca gcc agc acg ctt cca cac ggc gac aat atc ttg gct aca cct cat Pro Ala Ser Thr Leu Pro His Gly Asp Asn Ile Leu Ala Thr Pro His 310 315 320 325			1075
gct gcc gac att ttc gaa ggt acc ttg cgg tca aat att tcc atg aat Ala Ala Asp Ile Phe Glu Gly Thr Leu Arg Ser Asn Ile Ser Met Asn 330 335 340			1123

cat gag gac aac gtg cca att gat ccg cag gta att cgc gct tct ggt 1171  
 His Glu Asp Asn Val Pro Ile Asp Pro Gln Val Ile Arg Ala Ser Gly  
                   345                  350                  355

ctg act gac atc att gag gtg gac gga ctt gat gcg ccg gtg cgc gat 1219  
 Leu Thr Asp Ile Ile Glu Val Asp Gly Leu Asp Ala Pro Val Arg Asp  
                   360                  365                  370

acg gga agc aat tta tcg ggt ggg cag cgt cag cga gtg gct ttg gcc 1267  
 Thr Gly Ser Asn Leu Ser Gly Gly Gln Arg Gln Arg Val Ala Leu Ala  
                   375                  380                  385

agg gcg ttg cat gca gac gcg gaa gta ctg gtg ctg atg gat cca acc 1315  
 Arg Ala Leu His Ala Asp Ala Glu Val Leu Val Leu Met Asp Pro Thr  
                   390                  395                  400                  405

agc gcg gtg gat tca gtg acg gag gtg tct atc gcg cag ggg att aag 1363  
 Ser Ala Val Asp Ser Val Thr Glu Val Ser Ile Ala Gln Gly Ile Lys  
                   410                  415                  420

cag ctg cga gca ggc aaa acc acc att gtg gtg agt tct tcg ccc gcg 1411  
 Gln Leu Arg Ala Gly Lys Thr Thr Ile Val Val Ser Ser Ser Pro Ala  
                   425                  430                  435

ttt tac aac ttg gcg gat cgg gtg att tca cat gtc taatttgatg 1457  
 Phe Tyr Asn Leu Ala Asp Arg Val Ile Ser His Val  
                   440                  445

gcatcatcga cac 1470

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 <213> Corynebacterium glutamicum

<400> 284  
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Val Asp His Ala Val Leu Thr Lys Asp Leu Arg Arg Leu Val Val Gly  
                   20                  25                  30

Leu Val Ala Phe Val Val Leu Phe Val Val Leu Ser Phe Ser Asn Arg  
                   35                  40                  45

Phe Gly Ser Arg Ala Leu Asn Arg Ala Val Asn Phe Glu Ser His Ala  
                   50                  55                  60

Leu Arg Val Glu Val Ala Asp His Ala Leu Lys Asn Leu Asp Pro Arg  
   65                  70                  75                  80

Asn Leu Val Pro Gly Glu Val Met Ser Arg Ser Thr Ala Asp Ala Asp  
                   85                  90                  95

Ser Ser Thr Arg Ile Phe Gly Gln Ile Gly Thr Gly Val Ser Ala Ala

100						105					110				
Thr	Gly	Phe	Leu	Gly	Ala	Ala	Thr	Tyr	Leu	Leu	Ile	Ser	Asp	Trp	Leu
115						120					125				
Val	Gly	Leu	Leu	Val	Leu	Val	Leu	Val	Pro	Ile	Ile	Ser	Gly	Val	Val
130						135					140				
Ala	Leu	Ala	Ser	Lys	Gly	Ile	Ser	Lys	Arg	Ser	Val	Thr	Gln	Gln	Glu
145						150					155				
Lys	Leu	Ala	Glu	Ser	Gly	Ala	Gln	Ala	Ser	Asp	Ile	Met	Met	Gly	Leu
165						170					175				
Arg	Val	Ile	Lys	Ala	Ile	Gly	Gly	Glu	Arg	Trp	Ala	Val	Lys	Thr	Phe
180						185					190				
Glu	Lys	Ala	Ser	Gln	Ala	Ser	Ala	Arg	Ala	Ala	Val	Asp	Thr	Ala	Val
195						200					205				
Ala	Ser	Gly	Lys	Val	Ala	Gly	Ile	Gly	Glu	Leu	Ser	Ile	Ala	Val	Asn
210						215					220				
Leu	Ala	Ala	Val	Leu	Leu	Leu	Ala	Gly	Trp	Arg	Val	Thr	Thr	Gly	Glu
225						230					235				
Leu	Gly	Pro	Gly	Gln	Leu	Ile	Ala	Ile	Val	Gly	Val	Ala	Val	Tyr	Leu
245						250					255				
Ser	Glu	Pro	Ile	Arg	Leu	Leu	Ser	Asn	Ser	Ile	Asn	Ala	Ser	Ala	Ile
260						265					270				
Ala	His	Gly	Ala	Ala	Glu	Arg	Val	Ala	Asn	Phe	Leu	Asn	Leu	Asp	Glu
275						280					285				
Ser	Gln	Ala	Gln	Tyr	Glu	Ser	Ser	Glu	Thr	Ile	Asn	Asp	Gly	Glu	Phe
290						295					300				
Leu	Val	Ile	Val	Pro	Pro	Ala	Ser	Thr	Leu	Pro	His	Gly	Asp	Asn	Ile
305						310					315				
Leu	Ala	Thr	Pro	His	Ala	Ala	Asp	Ile	Phe	Glu	Gly	Thr	Leu	Arg	Ser
325						330					335				
Asn	Ile	Ser	Met	Asn	His	Glu	Asp	Asn	Val	Pro	Ile	Asp	Pro	Gln	Val
340						345					350				
Ile	Arg	Ala	Ser	Gly	Leu	Thr	Asp	Ile	Ile	Glu	Val	Asp	Gly	Leu	Asp
355						360					365				
Ala	Pro	Val	Arg	Asp	Thr	Gly	Ser	Asn	Leu	Ser	Gly	Gly	Gln	Arg	Gln
370						375					380				
Arg	Val	Ala	Leu	Ala	Arg	Ala	Leu	His	Ala	Asp	Ala	Glu	Val	Leu	Val
385						390					395				
400															
Leu	Met	Asp	Pro	Thr	Ser	Ala	Val	Asp	Ser	Val	Thr	Glu	Val	Ser	Ile

405 410 415  
 Ala Gln Gly Ile Lys Gln Leu Arg Ala Gly Lys Thr Thr Ile Val Val  
 420 425 430

Ser Ser Ser Pro Ala Phe Tyr Asn Leu Ala Asp Arg Val Ile Ser His  
 435 440 445

Val

<210> 285  
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 <212> DNA  
 <213> Corynebacterium glutamicum

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 <222> (101)..(1345)  
 <223> RXN01102

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 Val Ala Val Leu Val  
 1 5

gcg gtt gca gca gcg ttc ggc agt tgg tca ctc ctt ctt ccc gtc gta 163  
 Ala Val Ala Ala Ala Phe Gly Ser Trp Ser Leu Leu Leu Pro Val Val  
 10 15 20

ccg cta gcg gtc ctc aac aac ggc gga tca agc gct gtc gcc ggt gcc 211  
 Pro Leu Ala Val Leu Asn Asn Gly Gly Ser Ser Ala Val Ala Gly Ala  
 25 30 35

acc act ggc atc ttc atg gca gct aca gtg atc act cag att ttc act 259  
 Thr Thr Gly Ile Phe Met Ala Ala Thr Val Ile Thr Gln Ile Phe Thr  
 40 45 50

ccc gct gcg ctg cgg aaa att ggc tac acc cca gtg atg gct ttc gcc 307  
 Pro Ala Ala Leu Arg Lys Ile Gly Tyr Thr Pro Val Met Ala Phe Ala  
 55 60 65

gca ttc atg ctg ggt gtg cca gcc atc ggg tac atc ttc agc gtc gag 355  
 Ala Phe Met Leu Gly Val Pro Ala Ile Gly Tyr Ile Phe Ser Val Glu  
 70 75 80 85

cca att cca gtg ctg gta gtg tcc gca ctt cga gga att ggg ttc ggt 403  
 Pro Ile Pro Val Leu Val Val Ser Ala Leu Arg Gly Ile Gly Phe Gly  
 90 95 100

gcg ctc acc gtc gca gaa tct gcg ttg gtg gct gaa ctc gtt ccc gta 451  
 Ala Leu Thr Val Ala Glu Ser Ala Leu Val Ala Glu Leu Val Pro Val  
 105 110 115

cgc ttc ttg ggc aaa gct tct gga atg ttg ggc gta ttt att ggc ctt	499
Arg Phe Leu Gly Lys Ala Ser Gly Met Leu Gly Val Phe Ile Gly Leu	
120 125 130	
tcc caa atg ctt ttc ctg cct gcc ggg ttg gcg tta ggt gac caa ttt	547
Ser Gln Met Leu Phe Leu Pro Ala Gly Leu Ala Leu Gly Asp Gln Phe	
135 140 145	
ggc tac aac gtg gtc tat gtt tta ggt gcc gtt atc gca cta gtt gca	595
Gly Tyr Asn Val Val Tyr Val Leu Gly Ala Val Ile Ala Leu Val Ala	
150 155 160 165	
gcg gtg atg tgt ctg cgt att ccg cag gtt aag gca gcg gca aag cag	643
Ala Val Met Cys Leu Arg Ile Pro Gln Val Lys Ala Ala Ala Lys Gln	
170 175 180	
caa cca cag gtg agc gaa cag gag cgt tct gtt tcc acc tgg aag ttg	691
Gln Pro Gln Val Ser Glu Gln Glu Arg Ser Val Ser Thr Trp Lys Leu	
185 190 195	
gtg ctg gtt ccc tcc ttg gct gtt acc agt ttg tca atg act ttt ggc	739
Val Leu Val Pro Ser Leu Ala Val Thr Ser Leu Ser Met Thr Phe Gly	
200 205 210	
gca gtg tct tca ttc ctt cca gct gca gtc att gag tta gat cca gga	787
Ala Val Ser Ser Phe Leu Pro Ala Ala Val Ile Glu Leu Asp Pro Gly	
215 220 225	
tta ggt gct gca tta gcg ggt att att tta tcc att acc ggt ggt tct	835
Leu Gly Ala Ala Leu Ala Gly Ile Ile Leu Ser Ile Thr Gly Gly Ser	
230 235 240 245	
tca atg gtg ttc cgc tac ctg tcc ggc gtt atc gct gac cgc cgc ggt	883
Ser Met Val Phe Arg Tyr Leu Ser Gly Val Ile Ala Asp Arg Arg Gly	
250 255 260	
gtg cct ggt acc acg atg att cct gct cag atc att ggg ttc tta ggt	931
Val Pro Gly Thr Thr Met Ile Pro Ala Gln Ile Ile Gly Phe Leu Gly	
265 270 275	
gtc gtt tta atc acc gtc aca atc ttc caa ggc tgg tcc gtg tgg ctt	979
Val Val Leu Ile Thr Val Thr Ile Phe Gln Gly Trp Ser Val Trp Leu	
280 285 290	
ttg att ata ggt gca gtg atg ttt ggt ggt gct ttt ggc atg gtg caa	1027
Leu Ile Ile Gly Ala Val Met Phe Gly Gly Ala Phe Gly Met Val Gln	
295 300 305	
aac gaa gcg ttg ctt tca atg ttt ttc cgg ctt cct cgc act aga gtc	1075
Asn Glu Ala Leu Leu Ser Met Phe Phe Arg Leu Pro Arg Thr Arg Val	
310 315 320 325	
tcc gaa gcc tcc gcc atc tgg aat atc gcc ttt gat tcg gga aca gga	1123
Ser Glu Ala Ser Ala Ile Trp Asn Ile Ala Phe Asp Ser Gly Thr Gly	
330 335 340	
atc gga agc ttc ctc ctt ggc ata gtt gcc gca tcg ctt gct tac agt	1171



Ile Gly Ser Phe Leu Leu Gly Ile Val Ala Ala Ser Leu Ala Tyr Ser  
 345 350 355

ggt gct ttt ggt tcc gga gcc gtg gtg att ttg ttt gga atc gtt ttg 1219  
 Gly Ala Phe Gly Ser Gly Ala Val Val Ile Leu Phe Gly Ile Val Leu  
 360 365 370

acc acc gcc gat cga atc att ggg cgg cac cgc att act gaa tac aac 1267  
 Thr Thr Ala Asp Arg Ile Ile Gly Arg His Arg Ile Thr Glu Tyr Asn  
 375 380 385

aac acc cgc gcg cgt ttg cgc cag gtg cca gtc gct cgg cgt gca gtg 1315  
 Asn Thr Arg Ala Arg Leu Arg Gln Val Pro Val Ala Arg Arg Ala Val  
 390 395 400 405

caa ggg ctg cgc aac agg cgc aaa gat cgc taaaacgctt ttcgacgcca 1365  
 Gln Gly Leu Arg Asn Arg Arg Lys Asp Arg  
 410 415

ccc 1368

<210> 286

<211> 415

<212> PRT

<213> Corynebacterium glutamicum

<400> 286

Val Ala Val Leu Val Ala Val Ala Ala Ala Phe Gly Ser Trp Ser Leu  
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Leu Leu Pro Val Val Pro Leu Ala Val Leu Asn Asn Gly Gly Ser Ser  
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Ala Val Ala Gly Ala Thr Thr Gly Ile Phe Met Ala Ala Thr Val Ile  
 35 40 45

Thr Gln Ile Phe Thr Pro Ala Ala Leu Arg Lys Ile Gly Tyr Thr Pro  
 50 55 60

Val Met Ala Phe Ala Ala Phe Met Leu Gly Val Pro Ala Ile Gly Tyr  
 65 70 75 80

Ile Phe Ser Val Glu Pro Ile Pro Val Leu Val Val Ser Ala Leu Arg  
 85 90 95

Gly Ile Gly Phe Gly Ala Leu Thr Val Ala Glu Ser Ala Leu Val Ala  
 100 105 110

Glu Leu Val Pro Val Arg Phe Leu Gly Lys Ala Ser Gly Met Leu Gly  
 115 120 125

Val Phe Ile Gly Leu Ser Gln Met Leu Phe Leu Pro Ala Gly Leu Ala  
 130 135 140

Leu Gly Asp Gln Phe Gly Tyr Asn Val Val Tyr Val Leu Gly Ala Val  
 145 150 155 160

Ile Ala Leu Val Ala Ala Val Met Cys Leu Arg Ile Pro Gln Val Lys  
 165 170 175  
 Ala Ala Ala Lys Gln Gln Pro Gln Val Ser Glu Gln Glu Arg Ser Val  
 180 185 190  
 Ser Thr Trp Lys Leu Val Leu Val Pro Ser Leu Ala Val Thr Ser Leu  
 195 200 205  
 Ser Met Thr Phe Gly Ala Val Ser Ser Phe Leu Pro Ala Ala Val Ile  
 210 215 220  
 Glu Leu Asp Pro Gly Leu Gly Ala Ala Leu Ala Gly Ile Ile Leu Ser  
 225 230 235 240  
 Ile Thr Gly Gly Ser Ser Met Val Phe Arg Tyr Leu Ser Gly Val Ile  
 245 250 255  
 Ala Asp Arg Arg Gly Val Pro Gly Thr Thr Met Ile Pro Ala Gln Ile  
 260 265 270  
 Ile Gly Phe Leu Gly Val Val Leu Ile Thr Val Thr Ile Phe Gln Gly  
 275 280 285  
 Trp Ser Val Trp Leu Leu Ile Ile Gly Ala Val Met Phe Gly Gly Ala  
 290 295 300  
 Phe Gly Met Val Gln Asn Glu Ala Leu Leu Ser Met Phe Phe Arg Leu  
 305 310 315 320  
 Pro Arg Thr Arg Val Ser Glu Ala Ser Ala Ile Trp Asn Ile Ala Phe  
 325 330 335  
 Asp Ser Gly Thr Gly Ile Gly Ser Phe Leu Leu Gly Ile Val Ala Ala  
 340 345 350  
 Ser Leu Ala Tyr Ser Gly Ala Phe Gly Ser Gly Ala Val Val Ile Leu  
 355 360 365  
 Phe Gly Ile Val Leu Thr Thr Ala Asp Arg Ile Ile Gly Arg His Arg  
 370 375 380  
 Ile Thr Glu Tyr Asn Asn Thr Arg Ala Arg Leu Arg Gln Val Pro Val  
 385 390 395 400  
 Ala Arg Arg Ala Val Gln Gly Leu Arg Asn Arg Arg Lys Asp Arg  
 405 410 415

<210> 287  
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 <212> DNA  
 <213> Corynebacterium glutamicum

<220>  
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&lt;222&gt; (101)..(325)

&lt;223&gt; RXN00788

&lt;400&gt; 287

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 Asn Ile Gly Val Phe Asn Leu Gly Asn Ala Val Ala Ala Trp Leu Ala  
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 Gly Gly Leu Met Thr Ser Leu Gly Leu Val Leu Ala Ile Val Ala Val  
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 Val Leu Arg Arg Lys Ala Gln Gly Thr Gln Ala Thr Ile Ser Val Val  
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 Glu His Gln Pro Ala Gln  
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&lt;210&gt; 288

&lt;211&gt; 75

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 288

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Ser Ala Gly Leu Val Gly Gly Leu Met Thr Ser Leu Gly Leu Val Leu  
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Thr Ile Ser Val Val Glu His Gln Pro Ala Gln  
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&lt;210&gt; 289

&lt;211&gt; 1764

&lt;212&gt; DNA

&lt;213&gt; Corynebacterium glutamicum

&lt;220&gt;

&lt;221&gt; CDS

&lt;222&gt; (101)..(1741)

&lt;223&gt; RXN02119

&lt;400&gt; 289

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Gly Thr Ala Thr Met Gly Thr Ser Val Ala Ile Gly Glu Ile Asp Gln  
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 Lys His Val Pro Asp Leu Pro Ile Ser Glu Val Arg Thr Leu Leu Ala  
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aat cgt cgt tgg cat gtc gag gct ggc gaa gtt agg gag cta 1741  
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 <213> Corynebacterium glutamicum

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 35 40 45

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Pro Ala Asp Ala Phe Val Gly Tyr Leu Pro Gln Glu His Thr Arg Thr

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Pro	Asp	Asn	Ala	Ala	Leu	Ala	Asp	Ala	Tyr	Ala	Glu	Ala	Leu	Asp	Arg			
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Trp	Met	Ala	Ser	Gly	Ala	Ala	Asp	Leu	Asp	Glu	Arg	Ile	Pro	Ile	Val			
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Leu	Ala	Asp	Leu	Gly	Phe	Glu	Leu	Pro	Thr	Ser	Thr	Leu	Met	Glu	Gly			
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Gly	Val	Val	Leu	Val	Ser	His	Asp	Arg	Glu	Phe	Leu	Ser	Arg	Cys	Val			
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Thr	Thr	Val	Leu	Glu	Leu	Asp	Leu	His	Gln	Asn	Ser	His	His	Val	Tyr			
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Gly	Gly	Gly	Tyr	Asp	Ser	Tyr	Leu	Glu	Glu	Arg	Ala	Val	Leu	Arg	Gln			
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His	Ala	Arg	Asp	Gln	Tyr	Glu	Glu	Phe	Ala	Glu	Lys	Lys	Lys	Asp	Leu			
			260					265					270					
Val	Ala	Arg	Ala	Arg	Thr	Gln	Arg	Glu	Trp	Ser	Ser	His	Gly	Val	Arg			
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Asn	Ala	Ile	Lys	Arg	Ala	Pro	Asp	Asn	Asp	Lys	Leu	Arg	Lys	Lys	Ala			
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Lys	Leu	Gln	Phe	Ser	Val	Gly	Lys	Ala	Ser	Arg	Ser	Ser	Ser	Val	Val			
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Ser	Thr	Leu	Asn	Asp	Ala	Ser	Phe	Thr	Gln	Gly	Asp	Phe	Thr	Leu	Gly			
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ccc gcg cca gca acc gtc aac gcg gta ttc aac aac agc aac ggc ttc 163
Pro Ala Pro Ala Thr Val Asn Ala Val Phe Asn Asn Ser Asn Gly Phe
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Phe Ser Thr Leu Gly Asp Gly Met Asn Gln Ala Ala Glu Gly Ala Thr	
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Thr Leu Ser Asp Gly Val Gly Ser Ala Asn Asp Gly Ala Val Gln Leu	
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Gly Ala Gln Ser Leu Ala Asp Gly Ala Ser Gln Leu Asp Thr Gly Leu	
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ggc tcc gcg gct aca ggc agc caa acg ctc gcc gac ggt cta tcc agc	499
Gly Ser Ala Ala Thr Gly Ser Gln Thr Leu Ala Asp Gly Leu Ser Ser	
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Leu Ser Ala Gly Thr Ala Gln Leu Gly Gln Gly Ala Thr Gln Val Ser	
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Asp Gly Val Gly Gln Leu Val Asp Gln Val Ala Pro Leu Thr Ala Tyr	
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Val Pro Asp Ile Asn Ser Gln Leu Ile Thr Leu Arg Asp Gly Ala Ala	
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acc att gcc tct gaa cta tct gat ccc tcc agc acc tac cgc tcc ggc	691
Thr Ile Ala Ser Glu Leu Ser Asp Pro Ser Ser Thr Tyr Arg Ser Gly	
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Val Asp Ser Ala Val Ser Ala Ser Gln Gln Leu Ala Ala Gly Leu Gln	
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acc ctg aaa gac gga tcc agc caa ctc agc atc ggt gca cgc acc ctc	787
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215 220 225	
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Ala Asp Gly Thr Ser Gln Leu Ala Ala Gly Ser Glu Gln Leu Val Val	
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Ser	Glu	Leu	Ala	Leu	Lys	Leu	Thr	Asp	Gly	Ala	Ser	Gln	Val	Pro	Thr		
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caa	gca	gga	gac	acc	aca	ccg	ctc	ttc	ggc	att	ggc	ctc	gca	cca	ttc	1027	
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Phe	Met	Ala	Val	Gly	Leu	Phe	Met	Gly	Ala	Thr	Val	Ala	Trp	Met	Ile		
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Pro	Ala	His	Pro	Ala	Gly	Leu	Trp	Met	Ala	Met	Val	Ala	Ile	Ser	Trp		
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gta	ttc	atc	tcc	att	acc	cat	atg	ttc	aac	aac	gtg	gca	gga	ccc	tcc	1315	
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Ala	Gly	Arg	Val	Leu	Ser	Ile	Val	Met	Met	Ser	Phe	Gln	Leu	Val	Ser		
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			425					430					435				
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Phe	His	Thr	Tyr	Asp	Pro	Ile	Thr	Tyr	Ala	Val	Asn	Leu	Val	Arg	Gln		
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	455					460					465						
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470                                      475                                      480                                      485

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 Thr Val Val Glu Thr Met Asp Thr Glu Phe Gly Val Arg Ile Val Asp  
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 Asn Met Leu Val Gly Phe Ser Thr Leu Gly Asp Gly Met Asn Gln Ala  
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 Ala Glu Gly Ala Thr Thr Leu Ser Asp Gly Val Gly Ser Ala Asn Asp  
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 Gly Ala Val Gln Leu Ala Asp Gly Ala Val Thr Leu Arg Asp Gly Ile  
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 Ala Ser Ala Asn Glu Gly Ala Gln Ser Leu Ala Asp Gly Ala Ser Gln  
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 Asp Gly Leu Ser Ser Leu Ser Ala Gly Thr Ala Gln Leu Gly Gln Gly  
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 Ala Thr Gln Val Ser Asp Gly Val Gly Gln Leu Val Asp Gln Val Ala  
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 Pro Leu Thr Ala Tyr Val Pro Asp Ile Asn Ser Gln Leu Ile Thr Leu  
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 Arg Asp Gly Ala Ala Thr Ile Ala Ser Glu Leu Ser Asp Pro Ser Ser  
                                     180                                    185                                    190  
 Thr Tyr Arg Ser Gly Val Asp Ser Ala Val Ser Ala Ser Gln Gln Leu  
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 Ala Ala Gly Leu Gln Thr Leu Lys Asp Gly Ser Ser Gln Leu Ser Ile

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Leu Asp Glu Gly Ser Ser	Glu Leu Ala Leu Lys Leu Thr Asp Gly Ala	
	260	265 270
Ser Gln Val Pro Thr Phe Ala	Asp Gly Ala Asp Thr Thr Ile Ala Thr	
	275	280 285
Pro Val Glu Thr Glu Gln Ala	Gly Asp Thr Thr Pro Leu Phe Gly Ile	
	290	295 300
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Val Ala Trp Met Ile Leu His Pro Ile	Ser Arg Arg Ala Leu Asp Ser	
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Phe Gln Leu Val Ser Ser Gly Gly Leu Tyr Pro Pro Glu Thr Gln Pro		
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	435	440 445
Asn Leu Val Arg Gln Met Ile Phe Asn Glu Thr Pro Ser Asn Asp Pro		
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Arg Phe Ile Gln Ala Ile Trp Val Leu Leu Phe Ile Trp Ala Leu Met		
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gaa ggc tac gag gtt gcc gac gcc atc gcg cag gaa gac tgg ccc gag 307  
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cta cgc ggc gag ttg ggc gat ttg ctg ttt cag acc gtg ttt cac gcc 355  
 Leu Arg Gly Glu Leu Gly Asp Leu Leu Phe Gln Thr Val Phe His Ala  
 70 75 80 85

caa atg gcg cgc gag gca ggc cat ttc gct ttg gtt gac gtg gtg aag 403  
 Gln Met Ala Arg Glu Ala Gly His Phe Ala Leu Val Asp Val Val Lys  
 90 95 100

gca att tcg gac aag atg gtt ttg cgc cat ccg cac gtg ttc ggc gcg 451  
 Ala Ile Ser Asp Lys Met Val Leu Arg His Pro His Val Phe Gly Ala  
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cag tcg aac gcg aaa tcc gcc gac cag cag gtg gaa gat tgg gaa gtc 499  
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atc aag gcg ccc gag cgc gcg ggc aaa gcg caa aag ggc gtt ttg gat 547  
 Ile Lys Ala Pro Glu Arg Ala Gly Lys Ala Gln Lys Gly Val Leu Asp  
 135 140 145

ggc gtc gcg ctg gga ctg cct gcc ctg atg cgc gcg acg aag ctg caa 595  
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                   35                                  40                                  45

Pro His Thr Ile Glu Glu Gly Tyr Glu Val Ala Asp Ala Ile Ala Gln  
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Glu Asp Trp Pro Glu Leu Arg Gly Glu Leu Gly Asp Leu Leu Phe Gln  
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Thr Val Phe His Ala Gln Met Ala Arg Glu Ala Gly His Phe Ala Leu  
                   85                                  90                                  95

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His Val Phe Gly Ala Gln Ser Asn Ala Lys Ser Ala Asp Gln Gln Val  
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Glu Asp Trp Glu Val Ile Lys Ala Pro Glu Arg Ala Gly Lys Ala Gln  
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Lys Gly Val Leu Asp Gly Val Ala Leu Gly Leu Pro Ala Leu Met Arg  
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&lt;222&gt; (101)..(334)

&lt;223&gt; RXS02979

&lt;400&gt; 295

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gcaccgtaag gcacgaaagt taccgaaagg actgggtccc atg acc gcc cca aac 115  
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act ctc aag caa aca act ctt cgc tct gat gag ttc tct tgc cca tcc 163  
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tgt gtc tcc aag att gaa aac aaa ttg aat gga ttg gat ggc gtc gac 211  
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aat gca gag gtg aag ttc tcc tcc gga aga atc ctt gtt gat cac gac 259  
 Asn Ala Glu Val Lys Phe Ser Ser Gly Arg Ile Leu Val Asp His Asp  
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ccc agc aag gtc tct atc aag gat cta gtc gct gca gtc gca gag gtt 307  
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ggc tac acc gca aag cca tca gca atc taaaactctc agttagacca 354  
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tta 357

&lt;210&gt; 296

&lt;211&gt; 78

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 296

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Leu Asp Gly Val Asp Asn Ala Glu Val Lys Phe Ser Ser Gly Arg Ile  
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          20                      25                      30

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 gaa gtt ttc gga ctc ctc gcg gac gcc act cga gtt cgc atc atc ttg 211  
 Glu Val Phe Gly Leu Leu Ala Asp Ala Thr Arg Val Arg Ile Ile Leu  
 25 30 35  
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 Ala Leu Arg Asn Ser Gly Glu Leu Ser Val Asn His Leu Ala Asp Ile  
 40 45 50  
 gtc gat aaa tcc ccc gca gca gtt tcc caa cac ctc gcc cgg ctg cgc 307  
 Val Asp Lys Ser Pro Ala Ala Val Ser Gln His Leu Ala Arg Leu Arg  
 55 60 65  
 atg gcc cga atc gtg tcc acc cgt caa gaa ggt caa cga gtt ttc tac 355  
 Met Ala Arg Ile Val Ser Thr Arg Gln Glu Gly Gln Arg Val Phe Tyr  
 70 75 80 85  
 aaa ctc acc aat gaa cac gca tca cag cta gtc tcc gac gct att ttt 403  
 Lys Leu Thr Asn Glu His Ala Ser Gln Leu Val Ser Asp Ala Ile Phe  
 90 95 100  
 cag gcg gaa cac acc att gcg gac ggc cag act ccc cca cac cac cac 451  
 Gln Ala Glu His Thr Ile Ala Asp Gly Gln Thr Pro Pro His His His  
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&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 300

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 35 40 45

His Leu Ala Asp Ile Val Asp Lys Ser Pro Ala Ala Val Ser Gln His  
 50 55 60

Leu Ala Arg Leu Arg Met Ala Arg Ile Val Ser Thr Arg Gln Glu Gly  
 65 70 75 80

Gln Arg Val Phe Tyr Lys Leu Thr Asn Glu His Ala Ser Gln Leu Val  
 85 90 95

Ser Asp Ala Ile Phe Gln Ala Glu His Thr Ile Ala Asp Gly Gln Thr  
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Pro Pro His His His Arg Glu Arg Glu Gln Ser  
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&lt;210&gt; 301

&lt;211&gt; 10

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 301

Ala Pro Ala Leu Gly Pro Thr Leu Ser Gly  
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&lt;210&gt; 302

&lt;211&gt; 10

&lt;212&gt; PRT

&lt;213&gt; Corynebacterium glutamicum

&lt;400&gt; 302

Gly Xaa Xaa Xaa Gly Pro Xaa Xaa Gly Gly  
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&lt;210&gt; 303

&lt;211&gt; 20

&lt;212&gt; DNA

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&lt;400&gt; 303

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<210> 304  
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BGI-124CPPC - 97 -

20

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199 32 230.9	9 July 1999 (09.07.1999)	DE
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199 41 382.7	31 August 1999 (31.08.1999)	DE

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patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,  
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For two-letter codes and other abbreviations, refer to the "Guid-  
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ning of each regular issue of the PCT Gazette.

(54) Title: CORYNEBACTERIUM GLUTAMICUM GENES ENCODING STRESS, RESISTANCE AND TOLERANCE  
PROTEINS

(57) Abstract: Isolated nucleic acid molecules, designated SRT nucleic acid molecules, which encode novel SRT proteins from *Corynebacterium glutamicum* are described. The invention also provides antisense nucleic acid molecules, recombinant expression vectors containing SRT nucleic acid molecules, and host cells into which the expression vectors have been introduced. The invention still further provides isolated SRT proteins, mutated SRT proteins, fusion proteins, antigenic peptides and methods for the improvement of production of a desired compound from *C. glutamicum* based on genetic engineering of SRT genes in this organism.



WO 01/00804 A3

# INTERNATIONAL SEARCH REPORT

International Application No <b>PCT/IB 00/00922</b>		
<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 7 C12N15/31 C12N1/21 C12Q1/68 C07K14/34		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) IPC 7 C07K C12N C12Q		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, BIOSIS		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE EBI [Online] AC X13385, 19 March 1999 (1999-03-19) BARASH S. ET AL.: "Enterococcus faecalis genome contig" XP002152527 abstract	6,8
X	--- JAEGER WOLFGANG ET AL: "A Corynebacterium glutamicum gene conferring multidrug resistance in the heterologous host Escherichia coli." JOURNAL OF BACTERIOLOGY, vol. 179, no. 7, 1997, pages 2449-2451, XP002152524 ISSN: 0021-9193 the whole document --- -/--	1,2, 8-19,22
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.</span> <span><input checked="" type="checkbox"/> Patent family members are listed in annex.</span> </div>		
° Special categories of cited documents :		
<div style="display: flex;"> <div style="flex: 1;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="flex: 1;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-size: 1.2em;">14 November 2000</div>		Date of mailing of the international search report <div style="text-align: center; font-size: 1.2em;">13. 02. 01</div>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer <div style="text-align: center; font-size: 1.2em;">Kania, T</div>



# INTERNATIONAL SEARCH REPORT

Inte:      nal Application No  
PCT/IB 00/00922

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WEHRMANN AXEL ET AL: "Different modes of diaminopimelate synthesis and their role in cell wall integrity: A study with <i>Corynebacterium glutamicum</i> ." JOURNAL OF BACTERIOLOGY, vol. 180, no. 12, June 1998 (1998-06), pages 3159-3165, XP002152525 ISSN: 0021-9193 cited in the application the whole document ---	1,2,8, 19,22
X	PETER H ET AL: "CORYNEBACTERIUM GLUTAMICUM IS EQUIPPED WITH FOUR SECONDARY CARRIERSFOR COMPATIBLE SOLUTES: IDENTIFICATION, SEQUENCING, AND CHARACTERIZATION OF THE PROLINE/ECTOINE UPTAKE SYSTEM, PROP, AND THE ECTOINE/PROLINE/GLYCINE BETAINE CARRIER, ECTP" JOURNAL OF BACTERIOLOGY, WASHINGTON, DC, US, vol. 180, no. 22, 1998, pages 6005-6012, XP000917352 ISSN: 0021-9193 the whole document ---	1,2, 8-19,22
X	CHAN MING-SHUN ET AL: "Cloning of m-fluorophenylalanine-resistant gene and mutational analysis of feedback-resistant prephenate dehydratase from <i>Corynebacterium glutamicum</i> ." BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS, vol. 219, no. 2, 1996, pages 537-542, XP002152526 ISSN: 0006-291X the whole document ---	1,2, 8-19,22
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X	WO 99 02692 A (YAGOSHI CHIZU ;AJINOMOTO KK JP); <del>KIMURA EIICHIRO (JP); NAKAMURA J)</del> 21 January 1999 (1999-01-21) the whole document & EP 1 002 866 A (AJINOMOTO KK) 24 May 2000 (2000-05-24) ---	1,2, <del>8-19,22,</del> 25-34
X	WO 88 09819 A (MASSACHUSETTS INST TECHNOLOGY) 15 December 1988 (1988-12-15)  the whole document ---	1,2, 8-19,22, 25-34
	-/--	

INTERNATIONAL SEARCH REPORT

Inte.      nal Application No  
PCT/IB 00/00922

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 607 827 A (PASTEUR INSTITUT) 10 June 1988 (1988-06-10) the whole document ---	1-38
A	EP 0 252 558 A (SCLAVO SPA) 13 January 1988 (1988-01-13) the whole document ---	35
P,X	DATABASE EBI [Online] AC AF237667, 14 March 2000 (2000-03-14) KIM H. AND LEE H.: "Nucleotide sequence of the lmrB gene in Corynebacterium glutamicum" XP002152528 abstract -----	1-24

# INTERNATIONAL SEARCH REPORT

national application No.  
PCT/IB 00/00922

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-38 partially

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: invention 1: claims 1-38 partially

An isolated nucleic acid molecule from *Corynebacterium glutamicum* encoding a stress, resistance, or tolerance gene disclaiming the F-designated genes in table 1. Said gene having the SEQ ID NO:1, homologs (at least 50% homology), variants, and DNA sequences hybridizing thereto, as well as vectors and host cells comprising said sequences. An isolated stress, resistance, or tolerance polypeptide from *C. glutamicum*. Said protein having the SEQ ID NO:2, homologs (at least 50% homology), and variants thereof. The use of said sequences to modify the production of or produce a fine chemical from said host cell, the fine chemical especially being an amino acid. A method for diagnosing the presence or activity of *Corynebacterium diphtheriae* in a subject employing said sequences. A host cell comprising said nucleic acid sequences wherein said sequences are disrupted modified, or under the control of a heterologous regulatory region.

2. Claims: inventions 2-122: claims 1-38 partially

as invention 1 but relating to the pairs of sequences as listed in Table 1 (apart from the ones disclaimed)

# INTERNATIONAL SEARCH REPORT

...information on patent family members

Inte. 'nal Application No

PCT/IB 00/00922

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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